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A Commission with a Great Opportunity

WHAT are to be the policies of the Federal Trade Commission? Will it check or will it help business men struggling with great trade and administrative problems? Will it follow the lead and imbibe the spirit of the several commissioners of corporations who have gone before it, or will it adopt a broad, statesmanlike policy that, while firm with violators of the law, will always strive to advance in the large the commercial well-being of the country and of those who are conducting its business affairs? What business interests need is not the attitude which the reports of the commissioners of corporations have revealed, but a sympathetic understanding of the economic problems of the times and a strong constructive governmental force to promote energetic and reputable trade practices. The opportunities which the commission will have to promote a larger business are of far greater importance to the future of the nation than the opportunities which it will have to regulate internal trade practices.

Protection of Water-Power Investors

IN the discussion on the water-power bill before a Senate committee at Washington a striking degree of insistence has been laid on the necessity of such legislation as will make the principal of investments safe. Mr. Sidney Z. Mitchell, an abstract of whose testimony is published in this issue of the ELECTRICAL WORLD, told how bankers are scrutinizing the foundations of utility securities with greater care than ever before. This is fortunate, because jeopardizing the rights of security holders with the expiration of limited franchises ought soon to become a thing of the past. The responsibility for seeing that these conditions cease to exist is not one to be disregarded idly; it belongs to lawmakers, bankers and corporation officials, to each in part. When new legislation is undertaken, as in this case, the way to a constructive policy is easy. The law can be made so explicit in regard to water-power rights on public lands that the banker shall know reasonably well to what extent the investor is protected and to what extent he must accept risk. While banking estimates as to the relative proportion of protection and risk must be largely guess-work, the risk is the factor that looms the larger. That bankers will reduce rates on capital as the degree of protection under the law increases is important enough to encourage reasonable legislation, but it is not so important as the plain fact that protection means plenty of capital for water-power development and therefore real conservation by utilization.

A Problem in Substation Design

SOONER or later every city equipped with a 220-volt direct-current system is forced to adopt the alternating-current system of distribution. With many cities there comes a time in the development when for the sake of economy it is necessary to abandon an old generating station in favor of a new one equipped with large turbo-generators and to convert the old station to a substation. In such instances an interesting question of design arises. Does it pay to install motor-generators with storage batteries for the sake of providing direct current to the distributing network, or should polyphase current be used throughout? What is the relative efficiency of the direct-current system compared with a system for distributing three-phase energy with proper reserve generators or in case of need even with a reserve of battery and reversed motor-generators? A good many well-informed engineers feel very strongly that if it were possible to start afresh in a city of considerable size and area the distribution chosen would be three-phase, direct current being left entirely out of the reckoning. Other engineers, equally firm in their convictions, hold to the opposite opinion. Certainly the loss of energy in the regular use of a substation with motor-generators and batteries is so considerable as to raise at least a legitimate question as to whether it might not be wiser to take the long step at the start and distribute three-phase energy from the substation. Aside from possible local questions which often decide such matters, polyphase distribution throughout would seem on the whole to be best suited for the purpose.

The Small Municipal Plants

WHEN the small totals of gross revenues of municipal electric central stations are considered, the development of these properties in this country lacks impressiveness. The returns of the Bureau of the Census for 1912, published elsewhere in this issue, show that of the total revenues the municipal plants received 7.7 and the commercial stations 92.3 per cent. The commercial stations had twelve times the income of the municipal plants. This is evidence that private capital has sought mainly the centers of greatest density of population. The census figures show that the municipal plants comprise 29.9 per cent of the total number of plants. When 29.9 per cent of the number of plants earn only 7.7 per cent of the gross revenues, it is clear that they are operated on a relatively small scale. Of the total number of municipal plants, 84.9 per cent are in communities of less than 5000 population. The tendency is so strongly in the direction of centralization

of generating facilities and long-distance transmission that it is likely before the expiration of the next census period in 1917 many of these small communities will be served by large systems. When they can be served from large distributing systems having satisfactory diversity in load, they become inviting to private capital. Development in this direction is economic progress and cannot be prevented.

Labor-Saving Transmission-Line Chart

The predetermination of the size of wire required for direct-current energy delivery, at a given distance, voltage and loss in transmission, is relatively very easy. The current strength in amperes to be delivered is the delivered watts divided by the delivered volts, because there is no indeterminate power-factor question with direct current. The line-voltage drop is known by assumption, and this divided by the delivered amperes gives the value of the ohms resistance in the line circuit. Hence the line resistance per mile follows at once, and a suitable wire table does the rest, by showing the size and linear weight of the needed wires.

In the case of an alternating-current transmission line one must include the fractional power-factor of the load and the induction as well as the resistance of the line. The result is that, although the problem may still be considered as comprised within the limits of simple arithmetic, yet the solution is lengthier to obtain and must be worked out by selection from among a number of trial cases, so that a considerable amount of paper, plumbago and midnight oil may have to be expended in any actual important case before the designing engineer is fully satisfied with the efficiency and economy of the projected line. In the case of a long transmission line, any gross mistake made in the predetermination of the conductors is likely to be costly. Consequently, engineers who have much to do with line computations are pretty sure to develop short cuts and labor-saving devices which will assist in carrying on the work.

A particular form of such labor-saving device is presented by Mr. H. B. Dwight in a chart on page 160 of this issue. It consists of what is technically called a "straight-line diagram," wherein a straight edge connecting two selected points on a pair of parallel graduated lines intersects another graduated line or lines in the point or points giving the required result. In this chart there are in all thirty-five parallel graduated lines. By the use of the diagram there is obtained a factor showing the voltage drop with but little additional computation. When the line exceeds 30 miles in length the effect of the capacitance is taken into account as a simple corrective term. In the case of very long lines, the author points out that a still further correction is needed for the effects of distributed capacitance, according to the simple hyperbolic-function theory. In practice, this correction is very small when dealing with frequencies of sixty cycles per second or less, and one does not have to include a consideration of higher harmonic frequencies. Hence for most of the practical purposes of energy transmission one may ignore the effects of distributed capacitance or the seductions of hyperbolic-function theory and treat the line as though its capacitance were lumped comfortably at the two ends.

Effect of Third Harmonic on Three-Phase Transformers

In the philosophy of alternating currents these always enjoy the attributes and blessings of an infinite number of harmonics, and the only question is how much enjoyment exists. A perfectly pure simple sine wave of alternating current, if it could exist, would be an absolute ascetic, and its enjoyment of its natural rights and privileges in upper harmonics would be nil. This is the compensating misfortune that Fourier fastened upon mankind when he bestowed on them the valuable heirloom of Fourier's theorem. Prior to his time, an alternating wave was just a wave, smooth or rough, and nothing more. He revealed the intrinsic capability of any wave to possess harmonics, as well as the methods for measuring them, and now we are unable to think of a wave as being without them. We have to think of them as inherently present, although in an extreme case it may happen that their magnitudes will be all zero.

It is a known property of an n-phase symmetrical alternating-current system that any such system, connected up polygonally into a closed circuit, cancels all its internal emfs except the nth and its multiples, the $3n$th, $5n$th, and so on. Hence, in a three-phase system connected in delta, the triple-frequency harmonic emfs and their multiples are the only emfs not canceled out. These unite into a resultant emf which will tend to produce a short-circuit current in the delta.

In the article on page 157 Mr. Richard C. Powell shows that when transformers are connected on a three-phase system in star-delta arrangement of primary and secondary windings there should be no triple-frequency harmonic short-circuit, because the star-connected primary tends to suppress these harmonics, but if there is an active neutral conductor on the primary side, the triple-frequency currents are permitted to flow and induce corresponding triple-frequency harmonics in the delta-connected secondary, which will then act as a short-circuit to them and give rise to heating.

The proper behavior of transformers in any connection is, of course, to deliver the energy they receive, except for the suitably small percentage of energy loss to which they are entitled by their designer and which is their admitted perquisite for performing their regular functions. The absorption of triple harmonic energy internally is a most improper behavior, and one which no well-constituted system should permit for one moment. But the moral of Mr. Powell's article is that if transformers are star-delta connected, and the primary has an active fourth wire or neutral conductor, and the impressed primary emfs enjoy the very common luxury

of a marked triple harmonic, then the powers of darkness will convoke and the secondaries will refuse to give up their triple harmonic energy. The inference is strong, therefore, that such an arrangement of primary and secondary circuits does not form a well-constituted system.

The Upbuilding of a Network

An extended account is given in this issue of an extremely practical and useful network distributing energy in twelve counties over 184 miles of high-tension lines. Like most such systems, there has been an aggregation of stations and smaller systems, resulting in a very effective network with nine generating stations, seven operated by steam and two by water power. The chief station, which is the main object of interest, is at Cedar Rapids, Ia., where fuel is readily obtained and there is an ample supply of water for condensation purposes. At this point 15,000 hp is available, including as the chief generating units two 4500-kva steam turbines in addition to one smaller turbine unit and two engine-driven units. The reconstruction of the station equipment has led to some interesting engineering features.

In the first place, the company operates a steam-heating system, steam being taken from the third stage of the large turbines for this purpose. The supply of circulating water for the condensers involves some unusual particulars. Water is taken from a lake, about 100 yd. distant, through a reinforced-concrete tunnel by means of three independent pumps, any or all of which can be used according to the output required. Thus arranged, it is easy to save considerable pumping during times of low-water temperature and readily to adapt the power required to the water demand. The scheme, of course, is not unfamiliar, but it is worth emphasizing. In the earlier stages of operation of this station, the condensing water was brought in and discharged from a duplex tunnel, the streams in which were separated by a brick partition. It was found that the brick was so inefficient as a heat insulator that the outflow water warmed the intake to an inconvenient degree, and when the present large turbo-generators were added entirely independent tunnels were built. Increased efficiency of operation gives apparent evidence of the gain made.

The coal-conveying machinery for the plant, too, is a little out of the ordinary. A monorail crane fitted with a grab-bucket is operated upon a structural iron runway reaching the tracks of the two railways over which coal is brought. Some of the coal comes in hopper-bottom cars and is easily managed, but when it comes in ordinary cars the grab-bucket takes it in and drops it into a link-belt conveyor which carries it to the hoppers over the stokers. The same conveyor dumps the ashes into a concrete hopper, from which they are removed to be used as ballast on the various electric-railway lines owned by the operating company. The installation of this coal-handling apparatus is reported to keep the cost of handling a ton of coal from cars to boilers, including the removal of the ash, down to about 9 cents a ton. A few features of the electric equipment of the station demand comment. In addition to the usual switchboard arrangements use is made of a relay bus with a large oil switch so arranged that by properly setting the disconnecting switches the spare switch can be substituted for any other main switch in use, thereby greatly facilitating the maintenance of the switch equipment.

The pole lines are for the most part of the ordinary wooden construction with steel wish-bone cross-arms and pin-type insulators having a large factor of safety. The lightning protection consists in the main of a single ground wire and aluminum-cell arresters. These lines deliver energy to twenty-eight substations, large and small. It will be interesting to watch the further evolution of the system, involving as it probably will the abandonment of some of the smaller stations and increase of equipment in those giving best promise of economy.

Short-Circuits on Transmission Systems

An eminent scientist once expressed the opinion that one knows thoroughly only that which he can state in numbers. The wisdom of this remark when applied to engineering facts is beyond question, yet many engineers are prone to content themselves with a "qualitative" notion rather than to exert the effort necessary to obtain a "quantitative" conception of phenomena which manifest any degree of complication. Particularly is this true in regard to the effects which occur in transmission lines under abnormal conditions caused by lightning discharges and short-circuits. The paper presented by Mr. I. W. Gross at the January meeting of the American Institute of Electrical Engineers is worthy of careful study by every engineer who is concerned with the transmission or distribution of electric energy.

The author first deduced formulas for expressing the forces of repulsion set up between the conductors of a cable or between the busbars when a short-circuit occurs. The numerical values of these forces, which are due to the magnetic field around the wires, may reach surprisingly large values, as much, for example, as 2.5 tons per foot in a cable or 0.5 ton per support in the case of a busbar. The temperature rise in cables due to the enormous power input at the beginning of a short-circuit was also treated by the author in a quantitative manner. It was shown that the limiting feature in selecting the proper size of cable may sometimes be the temperature rise which a short-circuit may occasion. A detailed analysis was made of the system of inserting reactances described by Mr. H. G. Stott at the midwinter convention of the Institute last year. Its many advantages over the feeder-reactance or bus-reactance schemes were shown by numerical examples. This system bids fair to supplant the other systems in the future. By means of Mr. Gross' analysis the merits of any possible arrangement may be expressed numerically and compared with the merits of any other system in use or contemplated.

LETTERS TO THE EDITOR

Under-Voltage Protection

To the Editor of the ELECTRICAL WORLD:

SIR:—Tie lines run between a station and its substation are usually designed to work under the heaviest requirement for service, with the natural consequence of their being worked at a lower safety factor than any other part of the copper distributing system. Circuit-breakers on these lines are generally set to operate far above the normal continuous load, to say nothing of the more or less common practice of "blocking" the breakers in times of the heaviest demand.

It is not difficult to foresee a situation where there may come a leak in a tie-line cable such as may completely destroy the cable at the remote end without tripping the breaker at the station end. Suppose that at a time when the load is normally light the insulation fails at a point so far from the station that the resistance will, in a measure, limit the rush of current. The conditions are then ideal for a slow "burnout."

As a means of insuring against this contingency, suppose the line to be equipped with several breakers, each having an "under-voltage" element so set that the breaker will operate in the event of a short-circuit with the attendant abnormal voltage drop. As may be readily seen, the near breaker would operate first, so that if the tie line happened to be a feeder the unaffected part would continue to operate. It is not hard to see the situation in a crippled system where the short-circuited part would be automatically "cut out," leaving the remainder of the system operative.

St. Louis, Mo. F. L. W. PEEBLES.

Letting the Public Know

To the Editor of the ELECTRICAL WORLD:

SIR:—Referring to your editorial "Letting the Public Know," in the issue of Jan. 2, I beg to call your attention to the fact that the Society for Electrical Development *is* telling the public that "while everything else has gone up in price, central stations are giving much more service than they did and that their prices are lower although their costs of help, material and capital are higher."

You say "one reason why many people do not realize this is that it has never been told to them." As a matter of fact, the Society for Electrical Development sent out to the daily press throughout the country short articles on this subject as far back as December, 1913, and has been repeating the statement in various ways in magazines throughout the year 1914. This is not said in any way to detract from the merits of President Scott's efforts to get the Class A members of the National Electric Light Association to carry on an educational campaign along these lines. Such a campaign is sadly needed. Any and every way in which this truth can be brought to the attention of the public is more than welcome, no matter from what source it may come.

I sincerely trust that President Scott will succeed in arousing the central stations to a realization of the necessity and value of such a campaign, but I also want the ELECTRICAL WORLD readers to recognize the fact that the Society for Electrical Development is, and has been, working along those lines.

J. M. WAKEMAN,

New York, N. Y. *General Manager Society for Electrical Development, Inc.*

The Small Lighting Consumer

To the Editor of the ELECTRICAL WORLD:

SIR:—The very live question of how profitably to extend electric-lighting service to smaller consumers than are now generally enjoying such service was recently discussed at length in a joint engineering meeting in Chicago following the presentation of a paper by Mr. S. E. Doane. This discussion served both to bring out forcibly the exact lines of development needed to make possible the service of the small consumer at a profit and also to indicate that gratifying progress is being made toward a realization of these ideas. It is now generally agreed by all students of this problem that the mere cost of electrical energy for operating modern incandescent lamps is so small that it need not stand in the way of the use of electric light in the smallest homes. The great obstacle to progress is the investment needed both by the company and by the consumer to get ready to serve such small consumers.

Some rather striking figures were brought out in the discussion referred to as to the investment and consequent fixed charges for various parts of the system from power plant to consumers' lamp sockets. The investment required in power plant and distributing equipment to bring service to the street in front of a consumer's premises seems surprisingly small, to those who have never analyzed the matter, when it is compared with the investment in equipment between the street mains and the lamp sockets where the ordinary meter system is used. In one specific case for which figures were given, assuming a four-outlet consumer, with a maximum demand of only 130 watts, which would be typical of many small cottages and apartments, it was shown that the total central-station and distributing system investment necessary to bring the service to the consumer was only $8, or about the equivalent of the price of a meter installed. These figures were based on an estimated cost of $500 per kw of peak load for the central-station generating and distributing equipment serving residence consumers and a diversity factor of 18.1 per cent, the latter being that determined for a group of Chicago residence consumers. It was suggested that the diversity factor of a group of small four-room cottages or apartments would probably be considerably higher than 18.1 per cent, possibly 40 per cent or more, which would bring the investment up to $18 or $20 for such a consumer, provided the plant investment remained the same. Even then, the cost of the equipment, from the street mains to the lamp sockets, under conditions and costs existing in most of our large cities, is likely to be about double that in the power station and distributing system.

In small towns the costs on the consumers' premises are considerably less than in large cities, but the central-station investment costs are also likely to be less. A part of the items of equipment between the street mains and the lamp sockets must be furnished by the central-station company and a part by the private consumer, but in the end the consumer must pay the fixed charges upon this investment, whoever owns it. Especially in the larger cities, the tendency has steadily been toward more rigid wiring specifications and increased cost of wiring. This, together with higher labor costs in cities, makes wiring prices much higher than in country towns, which doubtless has much to do with the more extensive development of the small-residence business in some country towns than in large cities. In country towns a record of one consumer for every five inhabitants is sometimes attained, while in large cities a record of one

consumer to ten inhabitants is considered remarkably good.

The consumer's end of the installation being so expensive, the logical way to attack the problem is to reduce the first costs. Both the methods of wiring and metering need attention. As is well known, the metering problem has been taken care of in a number of European cities by the use of the automatic maximum-demand limiting device commonly known as a flat-rate controller and by selling the service at a flat rate, with the limiting device to prevent abuse of the contract. Numerous American devices of this kind have been put on the market from time to time during the past twenty years, but the majority seem to have fallen by the wayside either on account of unreliability or high first cost—the two evils between which the designer of such devices must steer.

A complete revolution of wiring methods is essential if the wiring is to be made as safe as at present and considerably cheaper. Of course, some of the present cost of wiring is due to "red tape" in our large cities, in the shape of overhead and soliciting expense of the contractor or central station and of inspection fees. Nevertheless, it is gratifying to learn that efforts of the National Electric Light Association committee on residence wiring are bearing fruit to the extent that manufacturers are developing wiring systems with the aim of cutting down the cost of wiring small houses and apartments. It goes without saying that if the cost is to be reduced radical changes must be made in our present methods, and these will doubtless be opposed on general principles by a certain class of conservatives; but it is to be hoped that the majority of those with whom rests the approval of any new systems proposed will approach the matter in an open-minded way and will consider all the propositions upon their merit rather than with prejudice. American ingenuity should be able to meet the requirements of safe wiring at lower cost provided that it is not too much hampered by some of the present rather inconsistent requirements which have gradually grown upon us.

Simplified billing is another essential to such small service. City water-works departments in our American cities have for years been submitting their bills from two to four times a year instead of twelve times. The payment of such accounts at the office or at agencies also helps to reduce the cost of collection.

Chicago, Ill. JAMES R. CRAVATH.

Mr. Dow's Article on Rate-Making

To the Editor of the ELECTRICAL WORLD:

SIR:—Any disagreement with Mr. Dow's interesting and closely reasoned discussion of rates [see ELECTRICAL WORLD of Jan. 2, 1915, page 17] would be like the dispute as to whether the lame man had one leg longer than the other or one shorter than the other. Nevertheless, there are two points on which he might have put a different emphasis. The first is in regard to the value of the service. When rates are computed from costs along the lines laid down by Mr. Dow most excellent rates result—in fact, substantially the same rates that would be reached if the method outlined in the report of the rate research committee of the National Electric Light Association were followed—but the danger is that the necessary modifications of the computed costs are not always considered, and undue emphasis on the importance of costs is with the average manager apt to result in rates that are either so high that too few people take the service or so low that the central station cannot pay all its costs, and this again prevents development and is an injury to the public.

If, however, more importance be placed on the value, the result is that no one is prevented from using if he can be served at a profit from the existing plant, or if he *could* be served at a profit by a competing plant; and this is surely much better than if a cost theory is allowed to keep up rates.

The second place where Mr. Dow places a wrong emphasis is in regard to the costs of getting ready either for the demand or for the customer. Both of these are important, but the cost of actually producing energy, or kilowatt-hour cost, is more important than would appear from a cursory reading of Mr. Dow's article. If the demand be kept the same but kilowatt-hours be reduced, then a great deal of expense often assigned to demand turns out to be really a kilowatt-hour expense. Further, the kilowatt-hour bears a much closer relation to the value of service than does the measured demand; and, still more important, the density, or number of customers in a given area, is often more important than either kilowatt-hours or demand, or such customers' costs as meters and billing.

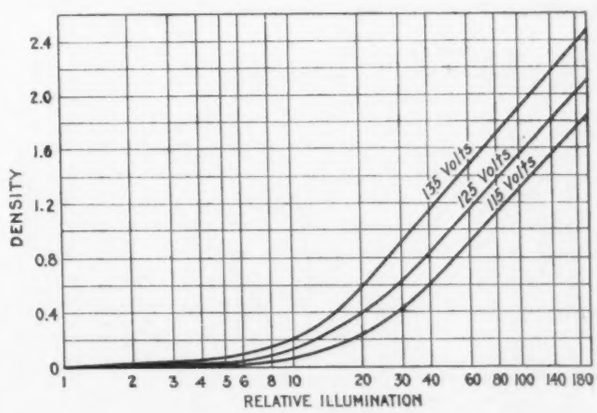
These points are all either covered in Mr. Dow's article or are a natural corollary from his discussion, and my only disagreement is in regard to the emphasis to be laid on them, and to the inferences which an unskilful rate-maker might draw if he read the article too hurriedly.

Boston, Mass. R. S. HALE.

The Tungsten Lamp in Photography

To the Editor of the ELECTRICAL WORLD:

SIR:—In my article on "Adapting the Tungsten Lamp to Photography," published in your issue of Nov. 14, 1914, I state that the data in Fig. 3 apply to the ordinary photographic plate (in this case Seed 30). However, these data apply to a plate made truly orthochromatic by the special screen described in a previous article. The data intended for Fig. 3 are indicated in the accompanying illustration, which shows the effect on



EFFECT OF VOLTAGE ON ACTINIC INTENSITY OF A 1000-WATT, 115-VOLT NITROGEN-FILLED TUNGSTEN LAMP

an ordinary plate (Seed 30) of increasing the voltage of a 1000-watt, 115-volt gas-filled tungsten lamp. In the case of the truly orthochromatic plate, obviously the actinic value of the radiation varies directly as the luminous intensity. However, ordinary plates being most sensitive in the violet region of the spectrum, the actinic value for these plates increases more rapidly than total luminous intensity as the voltage is increased. This is shown by comparing the two illustrations which are involved in the foregoing statement.

Cleveland, Ohio. M. LUCKIESH.

Interconnected Electric Service in Iowa

Combination Electric Railway and Lighting System Uniting Steam and Water Power Stations on a Growing Transmission Network

GENERATING electrical energy in a series of modern steam turbine stations, augmenting their output with smaller water-powers, and distributing the high-tension product into twelve counties, the equipment of the Iowa Railway & Light Company presents a notable example of the prevailing trend toward centralization of generating equipment for electric service. With its headquarters and main steam station at Cedar Rapids, Iowa, a pretty inland city with a population of 32,811, the company enjoys the advantages and transportation facilities offered by main lines of the Chicago & Northwestern and the Chicago, Rock Island & Pacific Railroads and branch lines of the Chicago, Milwaukee & St. Paul and the Illinois Central Railroads. The Cedar River and Cedar Lake furnish natural advantages in the way of a constant and dependable water supply, which not only is of value to the company for steaming and condensing purposes but also adds to the attractiveness of the city and the country in its vicinity.

184 Miles of 33,000-Volt Lines

The company's comprehensive transmission system, as now planned and for the large part completed, extends in a westerly direction from Cedar Rapids to the town of Perry, a distance of about 105 miles as the crow flies, but perhaps 25 miles farther following the transmission-line right-of-way. East and northeast from Cedar Rapids high-tension lines extend to Central City, Oxford Mills and Lowden, while electric railways reach Mount Vernon to the east and Iowa City to the south. When present plans are completed the company will own and operate 288 miles of 33,000-volt transmission lines, and at present 184 miles of this line are in service, serving a population totaling about 125,000.

Recently the company's main steam station at Cedar Rapids has been rehabilitated, another steam turbine, additional boiler equipment and a new switchboard being placed in service. As it now stands, the generating equipment of this station consists of two 4500-kva General Electric steam turbines, one 1500-kva Allis-Chalmers turbine, one 800-kw cross-compound Corliss engine and one 400-kw cross-compound Buckeye engine. Generators directly connected to all of these machines supply energy at two-phase, sixty cycles, 2300 volts. The engine-driven machines are designed to operate at 80 per cent power-factor. Inasmuch as the company supplies steam heat to the city of Cedar Rapids, the 4500-kva General Electric turbines are of the bleeder type, the steam for heating being taken from the third stage.

Wheeler condensers of the two-pass type, each with 10,500 sq. ft. of cooling surface, receive the exhaust steam from the 4500-kva turbines. The exhaust from the 1500-kva turbine is received by a Baragwanath vertical condenser with 5000 sq. ft. of surface. An Alberger condenser serving the 800-kw Corliss engine has 1600 ft. of cooling surface.

Circulating-Water System

Circulating water for these condensing units is brought to the station from Cedar Lake, about 100 yd. distant, through a reinforced-concrete tunnel. One 35-hp, 220-volt Westinghouse motor and two 75-hp, 2300-volt General Electric motors, connected to pumps capable of delivering 5000 gal. a minute and 10,000 gal. a minute respectively, deliver this water from the intake tunnel into a common circulating header. By this arrangement any or all of the pumps may be used to supply water to the condensers at rates varying from

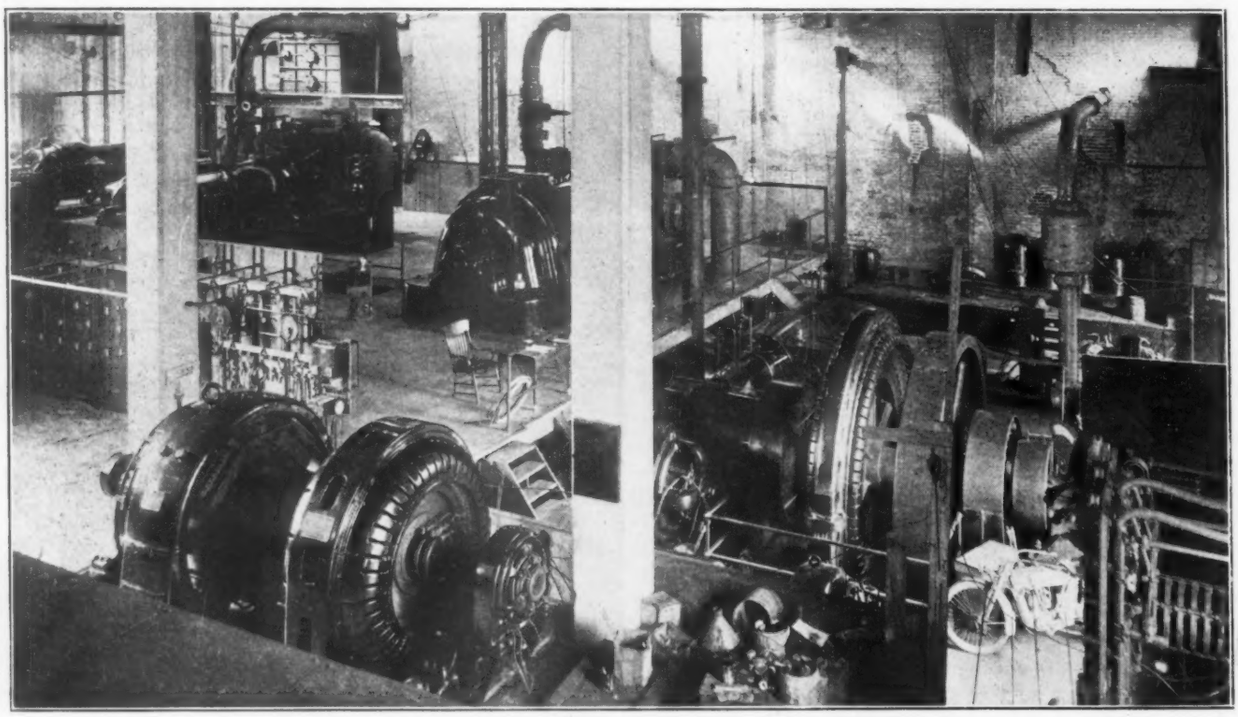


FIG. 1—INTERIOR OF PLANT AT CEDAR RAPIDS

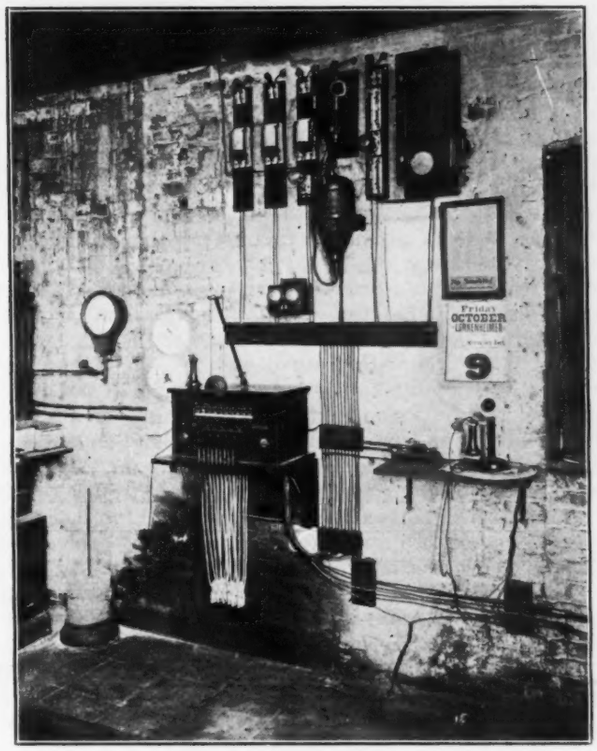


FIG. 2—TELEPHONE EQUIPMENT AT CEDAR RAPIDS

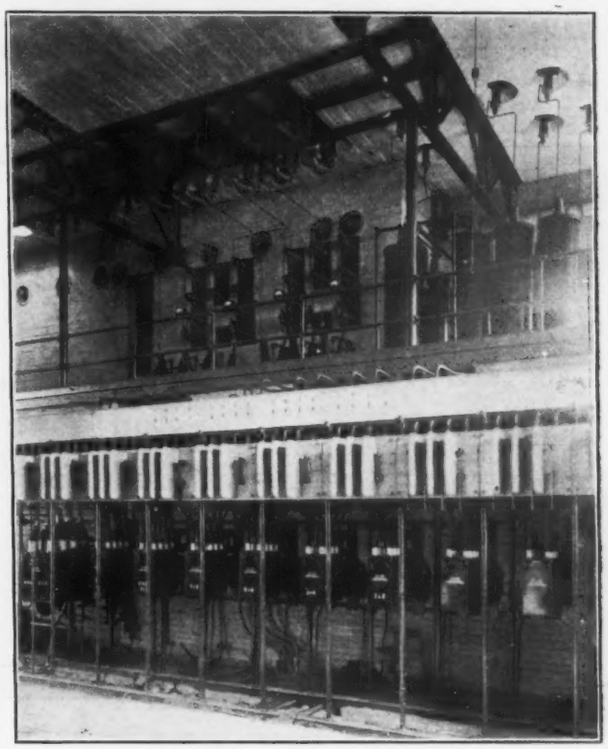


FIG. 3—FEEDER SWITCHES AT CEDAR RAPIDS

5000 gal. a minute to 25,000 gal. a minute. With variable weather conditions and consequent different water temperatures, this arrangement effects quite a saving, as the large pumps need not be started when cold weather will allow a small amount of water to provide the proper amount of condensing medium. These pumps are situated in the basement of the station, which has ample headroom, the generator room floor having been raised about 4.5 ft. during the process of rehabilitation. Visual signals, consisting of a pair of carbon-filament lamps for each set of pumps, have been arranged on the generating-room floor to keep operators informed as to what circulating pump is in operation. The vacuum pumps for the condenser are of the Mullin type and are driven by steam engines.

Two Tunnels Better Than One

Formerly the condensing water was brought in and discharged through a tunnel containing a brick partition. However, it was found that with this arrangement the incoming water was warmed by the outgoing water to a degree which made it ineffective, and hence another tunnel was built to be used entirely for discharged circulating water, the increased efficiency of operation seemingly showing this arrangement to be advantageous.

Excitation for the alternators is supplied by one 150-kw General Electric interpole engine-driven exciter and one 50-kw Bullock compound engine-driven machine. A 600-kw, 2300/650-volt synchronous motor-generator set comprises the only other direct-current apparatus in the station. The direct-current end of this machine has recently been insulated for 1200 volts, anticipating the increased operating voltage on one of the company's railways.

Features of the Boiler-Room Equipment

With the addition of two 638-hp Edge Moor boilers equipped with Taylor underfeed stokers, the boiler equipment has a total rating of approximately 6000 boiler hp. The remainder of the equipment is made up of six 600-hp Edge Moor boilers and two Babcock & Wilcox 500-hp units, all equipped with Foster superheaters and chain-grate stokers. All of the units deliver steam at 225-lb. pressure and 100 deg. superheat. One-half of the chain-grate stokers are driven by steam engines, while the other half are equipped with individual 5-hp motors. The Taylor stokers, which are of the seven-retort type, are steam-driven, and the fan and engine equipment supplied by the American Blower Company for furnishing forced draft are designed to operate the boilers at 300 per cent of their normal rating. Indicating steam-flow meters attached to each boiler unit supply the firemen with accurate information concerning the performance of each boiler.

In operating chain-grate stokers it is important that the fire be kept well up toward the front of the grate. By the ingenious arrangement of a small mirror set at an angle to a mica-covered hole in the boiler setting near the front of the grate, firemen are enabled to determine conditions in the furnace without opening the tuyeres and staring directly into the blaze.

At present feed water is heated in a 5000-hp Baragwanath open-type heater, but it is expected that in the near future a similar unit of 6000-hp rating will be installed. Feed water is delivered to the boiler by two boiler-feed pumps, one of which is a Canton Hughes unit capable of delivering 400 gal. of water a minute, while the other is a Worthington three-stage pump driven by a Terry steam turbine and is able to supply 475 gal. of water a minute.

Handling Coal and Ash for 9 Cents a Ton

A monorail crane equipped with a motor-driven grab bucket has been installed upon a structural iron runway so that it may reach the tracks of both the Illinois Central and the Chicago, Milwaukee & St. Paul Railroads. When the coal is not delivered in hopper-bottom cars it is lifted by means of the grab-bucket to a link-belt conveyor which delivers it to the hoppers over the stoker. The same link-belt conveyor also handles ashes, depositing them in a concrete hopper, from which they

are dumped in cars and used as ballast on the company's electric railways. The greater part of the coal, however, is not delivered to the station in hopper-bottom cars, and it is said that the average cost of handling a ton of coal, passing it to the coal bunkers through the stokers and delivering the ashes to the car, is approximately 9 cents a ton.

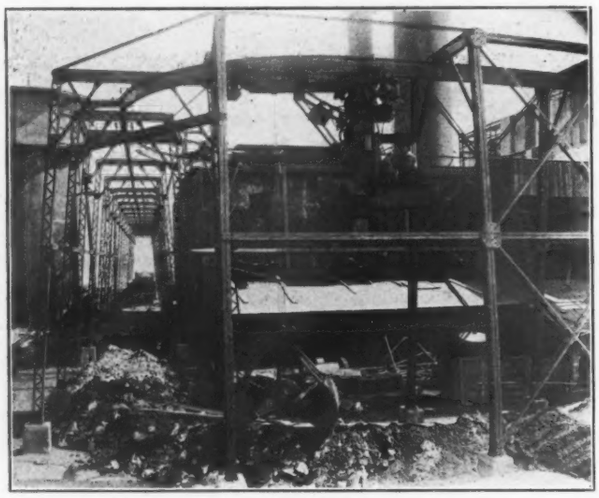


FIG. 4—COAL-HANDLING APPARATUS AT CEDAR RAPIDS

Only the boilers equipped with Taylor stokers operate on forced draft, natural draft for the remaining units being supplied by two reinforced-concrete stacks measuring 210 ft. in height and 13 ft. in diameter at the top. These stacks were built by the General Concrete Construction Company.

Synchronizing Plugs

A twenty-five-panel black oil-finished slate switchboard, consisting of five machine panels, three exciter panels, one motor-generator panel, one high-tension panel, one blank panel, one totaling panel and thirteen local feeder panels, controls the operation of the station. Quite a complex problem was involved in installing the new switchboard, as it stands in the same vertical plane occupied by the former board but at a height 4.5 ft. above the old switchboard site. However, by sawing the 2300-volt busbars into many sections and removing the circuits from one panel at a time, the entire transfer was made without an interruption to the service. Considering the character of the changes, it is notable that no one received the slightest injury during the progress of the work.

Throughout the company's system standard switchboards have been used, and an effort has been made to wire each board similarly to those in all other stations. Calibrating links on all series transformer leads eliminate the necessity of cutting the switchboard wiring for instrument calibration, thereby effecting a great saving in labor and increasing the assurance that the switchboard wiring will always remain as neat as when first installed. On the board at Cedar Rapids two extra points installed on the synchronizing plugs and sockets are connected in series with the operating circuit of the generating switches. With this arrangement it is impossible for the generator oil switch to be operated unless the synchronizing plug is in place. This precaution has been taken by the company's engineers to prevent any uninformed person tampering with the switch and interrupting the service of a large generator. The panels of all the company's switchboards rest on a 2-in. by 4-in. timber footing laid on the concrete floor of the stations to absorb vibration.

A Relay Bus and Extra Oil Switch

All switches are of the electrically operated remote-control type and are mounted together with disconnecting switches on iron-pipe framing in the northeast corner of the station under the gallery carrying the equipment for the outgoing high-tension line. In order to insure continuity of operation and to allow oil switches to be taken out of service for inspection or repairs, a relay bus and extra oil switch of sufficient capacity to carry the load from the largest of the oil switches have been installed. By manipulating the disconnecting switches this extra oil switch can be made to take the place of any other. Each of the disconnecting switches used with these oil-switch units is equipped with a safety latch to prevent its opening under heavy short-circuits. Protection from lightning is afforded by an aluminum-cell arrester on the 2300-volt bus and General Electric graded-shunt lightning arresters on each of the outgoing feeders. Varnished cambric cables terminating in potheads have been used throughout the works, and in designing the wiring layout cable sizes were selected to give a factor of safety of ten.

The high-tension equipment in the station supplying the outgoing 33,000-volt lines consists of two 600-kva, 2300-volt to 33,000-volt, two-phase to three-phase, sixty-cycle delta-connected, water-cooled transformers. Each outgoing line is equipped with a post-type 33,000-volt ammeter and disconnecting switches. Lightning protection is afforded by aluminum-cell arresters equipped with charging resistors and discharge recorders. The 33,000-volt bus structure consists of 0.25-in. copper tubing, the outgoing lines leaving the building through Thomas roof bushings. The features of the installation are the two-phase to three-phase connections and the liberal use of disconnecting switches allowing apparatus to be taken out of the circuit for repairs or inspection.

Other Generating Stations and Their Ratings

In addition to the 15,000-hp station at Cedar Rapids, the company owns and operates eight power houses, six of which are steam stations and two water-power stations. The rating and location of each of these stations are given in Table I.

The fact that the company is operating such a comparatively large number of small plants may be wondered at. In this connection it is to be said that at Marion and Perry, where the company operates central-station heating systems, the generating stations are shut down in the summer time, when no exhaust steam is needed. At Anamosa and Oxford Mills advantage is taken of small water-powers which have been developed, and these plants supply energy to the system throughout

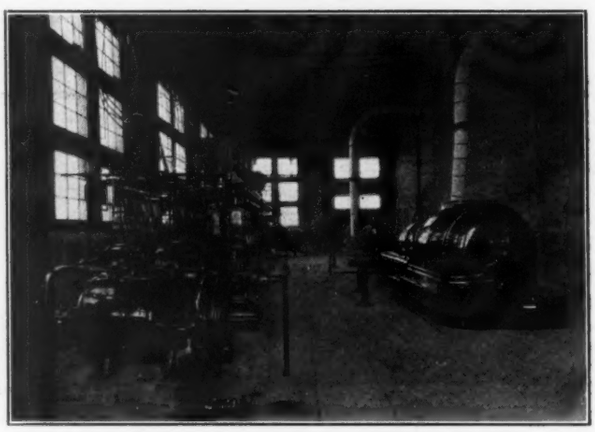


FIG. 5—GENERATOR ROOM IN BOONE POWER HOUSE

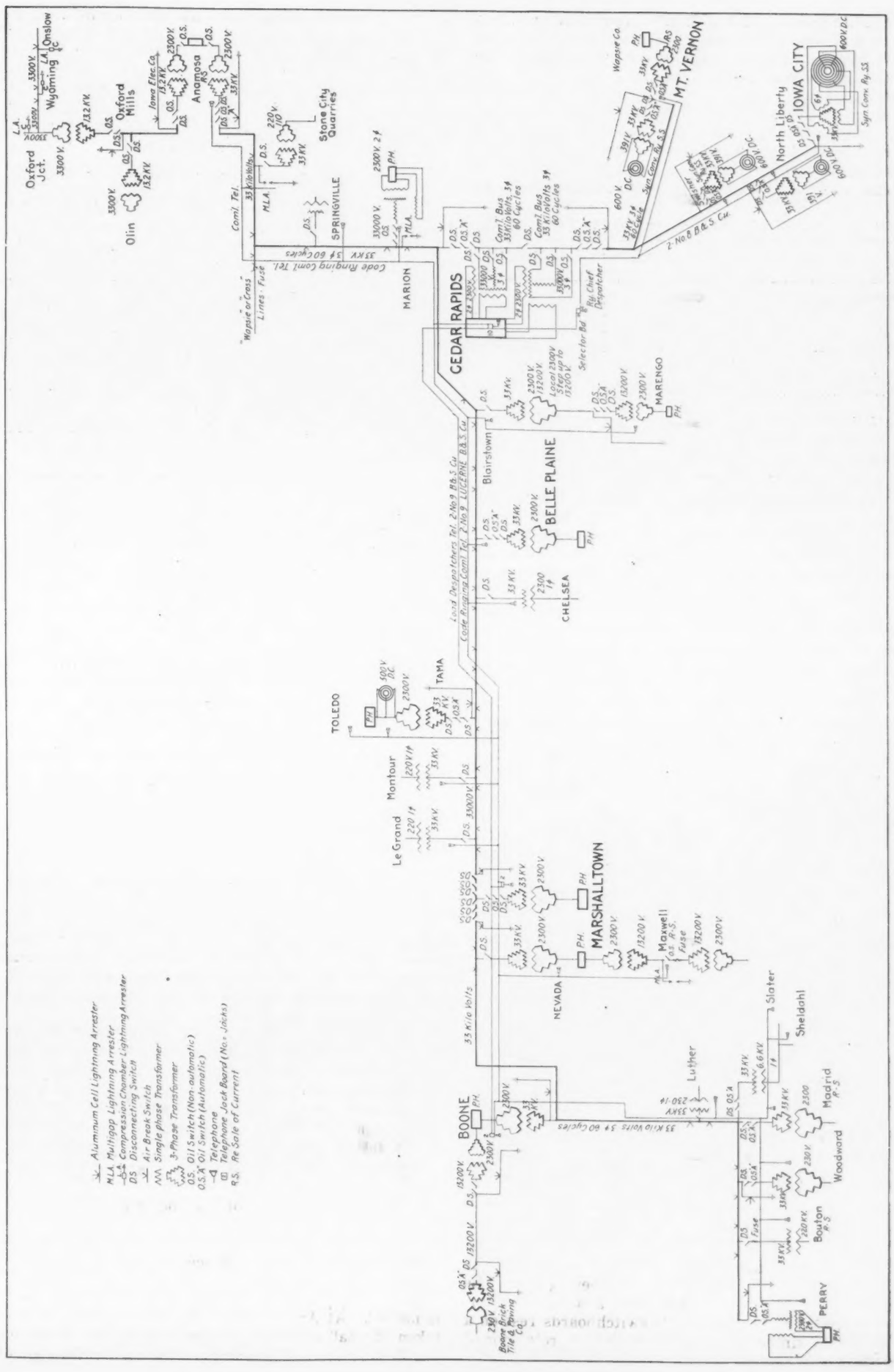


FIG. 6—MAP OF SYSTEM OF THE IOWA RAILWAY & LIGHT COMPANY

about nine months of the year. The stations at Belle Plaine and Nevada are being operated temporarily, but it is planned that transmission service will supplant the generators there in the near future.

Modern Steam Station at Boone

Within the past two years a modern steam generating station has been erected at Boone, which is almost at the extreme western end of the company's transmission system. Here the main generating units consist of two

TABLE I—GENERATING STATIONS OUTSIDE CEDAR RAPIDS

Location	Rating in Kw	Population
Marion	500	4,400
Belle Plaine	300	3,121
Marshalltown	2300	13,374
Nevada	250	2,138
Boone	2300	10,347
Perry	360	4,630
Anamosa	450	2,983
Oxford Mills	300	170

1000-kw Allis-Chalmers steam turbines delivering energy at 2300 volts, three-phase, sixty cycles, and designed to operate at 80 per cent power-factor. A 300-kw cross-compound Buckeye engine is the only other prime mover in the station. All of the units operate condensing, a part of the exhaust steam being used in the central-station heating system. Excitation for the main generators is supplied by two direct-current units, one being a 35-kw machine driven by a Curtis turbine, while the other is an Allis-Chalmers motor-generator set of the same rating. Either of these machines is capable of supplying sufficient energy for all of the direct-current apparatus in the station. Three 400-hp Edge Moor boilers supply steam to the turbines and also to the high-pressure steam mains of the Rockwell Brothers Ice Company. Draft for these units is furnished by a 175-ft. concrete stack measuring 8 ft. in diameter at the top. The coal is fired on chain-grate stokers, being shoveled to the hopper by hand.

A portion of the energy generated in this station is delivered over a 33,000-volt transmission line to the city of Perry. It is a notable fact that twenty-four-hour voltage charts taken at the end of this line show a variation in potential of less than 2 volts above and below the normal, 110 volts.

Liberal use of disconnecting switches has been made in the station at Boone. Disconnecting switches for the manually governed remote-control oil switches operated from the twelve-panel board have been placed on a slate base above the oil switches and behind the switchboard. Here they are near the apparatus they serve and also within easy reach of the operator.

The Company's Property at Marshalltown

In the city of Marshalltown the Iowa Railway & Light Company owns and operates the electric-light, gas and street-railway properties, and within the past year has spent approximately $70,000 making improvements within the city. The generating station here contains a 1500-kw, three-phase, sixty-cycle Westinghouse turbine exhausting into a Wheeler condenser. In addition to this large unit, there are a 500-kw, three-phase, sixty-cycle turbine and a 300-kw synchronous motor-generator set. The latter is so arranged that in times of emergency it can be driven by a Corliss engine through a clutch. Steam is furnished by three 500-hp Edge Moor boilers equipped with chain-grate stokers and operating under the natural draft supplied by a 175-ft. by 8-ft. stack.

The average daily output of the three main generating stations of the company is as follows: Cedar Rapids, 75,000 kw-hr. a day; Boone, 12,000 kw-hr. a day, and Marshalltown, 12,000 kw-hr. a day. On account of the character of the loads of large customers in Cedar Rapids, the peak load on the station in that city comes on at about 2:30 o'clock in the afternoon.

Supplementary Water-Powers

Flowing south and east to join the Mississippi, the Wapsipinicon River passes through Anamosa and Oxford Mills. At these two points the company is operating small water-power stations. The plant at Oxford Mills is equipped with four waterwheels driving a 300-kw generator which is unique in that its terminal potential is 3300 volts. The station at Anamosa, with 450-kw rating, contains five wheels belted to an Allis-Chalmers and a Bullock generator. In seasons when the

TABLE II—SUBSTATIONS OF THE IOWA RAILWAY & LIGHT COMPANY

Location	Rating in Kw	Population
Quaker Oats Company	3,000	.....
Perry	400	4,630
Bouton	40	100
Woodward	90	712
Madrid	120	1,191
Luther	30	130
Slater	50	473
Sheldahl	30	202
Boone	525	10,347
Marshalltown	900	13,374
Le Grand	35	338
Montour	35	383
Chicago & Northwestern shops at Boone	450	.....
Douglas & Company	1,150	.....
Gladbrook	90	869
Darwin	35	425
Toledo	525	1,626
Cedar Rapids	1,200	32,811
Marian	250	4,400
Springville	50	588
Stone City (quarries)	375	600
Central City	90	558
Center Point	75	280
Anamosa	375	2,983
Olin	150	659
Oxford Mills	225	170
Mount Vernon	375	1,532
Boone Brick Tile & Paving Company	375	.....
Total	11,015	79,381

flowage of the Wapsipinicon River is sufficient these plants operate at about a 9-ft. head, but at other times the machines are taken out of service and energy is supplied to the local systems through step-down transformers.

During the early part of 1914 the company reconstructed practically all of the distribution lines in the town of Anamosa. Co-operating with the Bell Telephone Company, all wires on the main street of the city were either placed underground or were replaced by lead cables through the alleys. Considering the jungle of wiring which formerly appeared both in the alleys and along the main street, it may be truthfully said that the reconstruction has worked wonders in beautifying the town. Poles which formerly carried primary and secondary wires without consideration for phase relations or voltages have been replaced with neat line construction. Transformer banks have been so arranged as to enable linemen to work on one side of the pole without fear of coming in contact with lines of high potential. The telephone company has installed cable wherever practicable, using multiple can-top terminals for bringing out the customers' service lines.

The 33,000-Volt Transmission System

With 184 miles of wooden-pole line in service and a little more than 100 additional miles in prospect or under construction, the company has a high-tension transmission system of which it is justly proud. Upon 100 miles of this 33,000-volt, three-phase, sixty-cycle line steel wishbone cross-arms have been used, while the

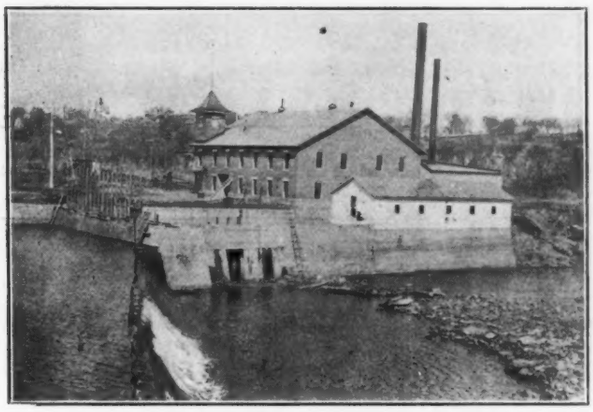


FIG. 7—HYDROELECTRIC STATION AT ANAMOSA

remaining 84 miles is equipped with wooden cross-arms. Most of the poles are of cedar, 30 ft. high with 7-in. tops, but where the transmission line follows the rights-of-way of the company's interurban roads 40-ft. cedar poles with 8-in. tops have been used, so that the necessary space will be provided for span wires and trolley brackets. About 100 cedar poles along the interurban line reaching Iowa City have been strengthened with Orr reinforcing. Poles along interurban roads are spaced approximately 100 ft. apart, while in the open country 150-ft. spans are used.

Throughout the entire system an effort has been made to space the high-tension wires at the vertices of an equilateral triangle measuring 52 in. on a side. The line wires in the main transmission line from Cedar Rapids to Boone are of No. 2 stranded copper, while other lines to the north, east and south of Cedar Rapids and the line from Boone to Perry are of No. 4 copper. Thomas, Pittsburgh and Locke insulators of the three-petticoat type tested for 120,000 volts dry and 70,000 volts wet are used on the system. In most cases the insulators are installed with steel pins. The single ground wire used throughout the system is of No. 6 copper-clad steel and is supported upon a 2.5-in. by 2.5-in. by 5-ft. angle-iron bayonet.

On the same poles with transmission lines a No. 8 copper circuit has been strung to provide telephone connection. As a rule, the telephone circuit is placed 10 ft. beneath the high-tension lines. Transpositions in the telephone line at intervals of 600 ft. render it unusually quiet. Insulating transformers have been used in telephone stations to protect the users from shock. All telephone switchboard apparatus was supplied by the Western Electric Company.

Long Spans at River Crossings

Two river crossings afford practically the only unusual construction on the transmission system. One of these is a 750-ft. span across the Cedar River in the city of Cedar Rapids. A single pole was used at each side of the river, 0.625-in. messenger wires holding each pole in three directions. The two-phase, four-wire circuit fastened to the cross-arms by means of wood strains exerts a pull in the fourth direction and establishes a stable condition. Each of the four wires of the feeder circuit is made of eight No. 12 copper-clad steel wires.

Another river span, 900 ft. in length, has been erected over the Des Moines River on the line connecting Boone and Perry. Here a structure consisting of two poles held together by heavy timbers and guyed four ways constitutes the terminal of the span. Straight poles 45 ft. high with 10-in. tops were selected for this service, and all of the anchors consist of creosoted railroad ties buried 6 ft. in the ground and held in place by several feet of concrete. In crossing the river the lines maintain their positions at vertices of an equilateral triangle measuring approximately 10 ft. on a side.

Indoor and Outdoor Substations

To travel by train and visit each town, each substation and each power house connected by the transmission lines of the Iowa Railway & Light Company would require a little more than two weeks. Of the twenty-eight substations in operation at present eight are of the outdoor type. Table II gives a list of the company's substations, and where towns are served gives the population of the community as shown by the 1910 census.

Most of the substations with ratings of 90 kw or less are of the single-phase type, while the larger ones are three-phase installations. Fixed charges on the original installation are usually an important item in deciding whether an indoor or an outdoor type substation shall be put in service. The high first cost of aluminum-cell lightning arresters, which the engineers of the company have adopted as standard lightning protection for indoor substations, increases the cost of each installation considerably and is one of the first things to be considered in the substation layout. The outdoor-type substations are as a rule protected by fuses of the explosion type or the horn type.

The Financial and Franchise Situation

In its financial organization the Iowa Railway & Light

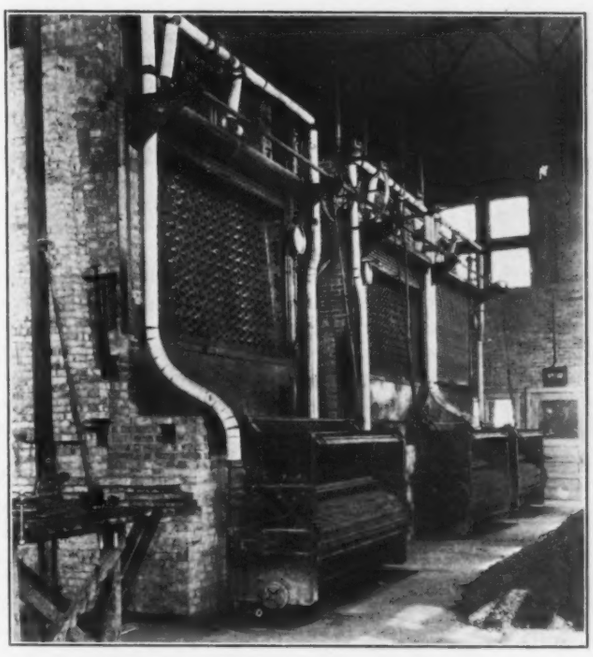


FIG. 8—BANK OF BOILERS AT BOONE

Company differs from many other large electric-service properties in that it is not a holding company. It owns all of its properties outright and not through underlying companies. Under the management of local capitalists who give the affairs of the company their personal attention, the company's gross revenue has been increased from less than $90,000 in 1903 to more than

$1,011,000 in 1913. Table III, included as part of a report to shareholders at the end of the year 1913, shows how well the finances of the company stood at that time.

TABLE III—CAPITALIZATION, EARNINGS AND EXPENSES

Capitalization	Authorized	Outstanding
Bonds	$10,000,000	$3,921,500
Preferred stock	3,000,000	1,266,395
Common stock	3,000,000	1,700,000

EARNINGS AND EXPENSES 1913

Gross earnings	$1,011,273.15
Operating expense, including taxes, maintenance and renewals	590,210.22
Net earnings	$421,06[illegible].23
Annual interest charge on outstanding bonds	172,759.53
Balance	$248,302.70

The franchise situations in the various towns in which the company operates is unusually satisfactory, both from the standpoint of the company and from that of the holders of its securities. With but two minor exceptions franchises containing no burdensome provisions have been granted for a period of twenty-five years. During the latter part of 1913 the city of Cedar Rapids entered into a contract with the company agreeing to construct a hydroelectric station on the Cedar River and sell the entire output of the station to the Iowa Railway & Light Company for a consideration of $10,000 a year. A part of the consideration of this contract was that the city should purchase all of its energy for street and municipal lighting from the company for the term of the contract, twenty-three years. This contract was approved by the City Council, and at a special election Dec. 15, 1913, the people authorized an issue of bonds to build a dam, raceways and other necessary structures. Thus the municipal-plant bugaboo in Cedar Rapids has been crowded far into the future, and the company's business has been placed in a secure position.

Connections with Other Companies and Organization

In addition to supplying energy for its own substations, the company sells energy at wholesale to other transmission companies, among which is the Wapsie Valley Light & Power Company. This company supplies the towns of Lisbon, Mechanicsville, Stanwood, Clarence, Lowden and Tipton. With their connection to the mains of the Iowa Railway & Light Company, these towns are receiving their first twenty-four-hour service.

Mr. William G. Dows is president and manager of the Iowa Railway & Light Company, and in his work he is assisted by Mr. John A. Reed, vice-president and general manager; Mr. Isaac B. Smith, vice-president and treasurer, and Mr. C. S. Woodward, secretary. Mr. S. C. Dows and Mr. R. C. Cook are purchasing agents. The engineering problems of the company are handled by Mr. F. W. Lass, mechanical engineer, and Mr. John M. Drabelle, electrical engineer. Mr. J. C. Young is manager of the new-business department. Mr. E. W. Lewis is superintendent of city transmission lines, and Mr. J. T. Hamilton is chief engineer of the Cedar Rapids power house. It is notable that in each of the cities and towns where properties are operated by the company the services of a local physician are retained so that he may render aid to the employees and others in times of emergency.

Hydroelectric Station on Government Dam

Some years ago the United States government erected a dam across the Rock River about a mile above Sterling, Ill., to divert water into a feeder for the "Hennepin" or Illinois & Mississippi Canal. Conceding that the building of this dam above the smaller existing dam of the Sterling Hydraulic Company had in a measure

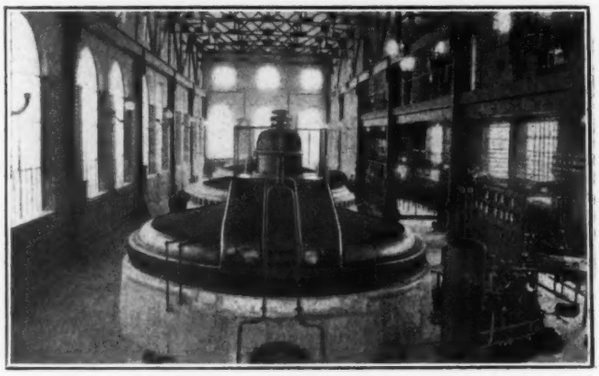


FIG. 1—INTERIOR OF POWER STATION

interfered with the water rights of the latter, permission was granted for the Sterling company to build a power house at the government dam. The Sterling Hydraulic Company then leased its rights for twenty-five years, with an option of twenty-five years additional, to the Rock River Light & Power Company. The power house, containing five 340-kva, 2300-volt, three-phase, sixty-cycle Allis-Chalmers alternators, was built by the Rock River Light & Power Company, and its output is being sold at wholesale to the Illinois Northern Utilities Company. Energy is delivered to Sterling at the generator voltage, and to Dixon and Prophetstown at 33,000 volts.

Fig. 1 shows an interior view of the station with one of the large, slow-speed alternators in the foreground. With the low head available—8.5 ft.—the 60-ton rotating elements of these machines operate at 60 r.p.m. Room has been provided for a sixth unit of similar size, and the station arrangement has been planned so that one governor can serve two generators. The switching equipment, transformers and high-tension apparatus are installed on galleries along the tailrace side of the

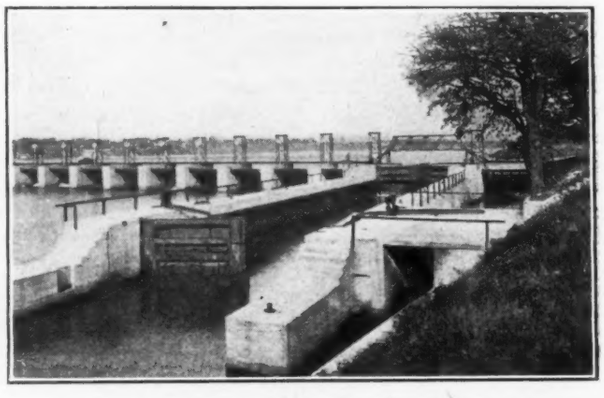


FIG. 2—GOVERNMENT LOCK AND TAINTER GATES

power house, and the outgoing 33,000-volt leads leave the building through roof bushings and are connected to the main line, which is deadened at a steel structure on the roof. The counterweighted tainter gates and the government lock, which are on the opposite shore of the river from the power house, are shown in Fig. 2.

Effect of Third Harmonic in Voltage Wave

Examination of Results When Triple-Frequency Voltage Is Impressed on Three-Phase Transformer Banks Connected in Various Ways

BY RICHARD C. POWELL

WHEN three transformers connected in star on the primary side and in delta on the secondary side are used in connection with a three-phase generator giving a voltage per phase containing only a small third harmonic a very large triple-frequency current may be set up in the transformers if the neutrals of the generator and of the primary of the transformers are interconnected. Calling e_3 the percentage value of the third harmonic in the generator voltage, it can be shown that a triple-frequency current equal in value to full-load current will be set up in the transformers, even though there is no external load, when e_3 has the values given in the following table. This table applies to 2400 = 120/240-volt, sixty-cycle, single-phase transformers connected Y-delta.

THIRD HARMONIC VOLTAGE TO PRODUCE FULL-LOAD CURRENT

Size, Kw	e_3, per Cent of Rated Voltage	Size, Kw	e_3, per Cent of Rated Voltage
1	3.1	10	5.5
3	4.7	15	6.9
4	5.7	20	7.1
5	4.8	30	8.5
7½	4.9	50	8.8

Values of e_3 for 6600-volt and 11,000-volt transformers will be somewhat higher, since transformers for these voltages have a somewhat higher per cent reactance.

Inasmuch as it is not uncommon to find a 10 to 15 per cent third harmonic in the phase voltage of a three-phase generator, it is evident from the above table that the actual value of the triple-frequency current set up in the transformers under the conditions stated may greatly exceed the value of the full-load current. For example, a 10 per cent third harmonic will produce approximately 200 per cent load current in a bank of three 5-kw, 2400-volt, sixty-cycle transformers. The writer has observed in a bank of three 100-kw transformers a triple-frequency current as high as 125 per cent of the rated current with no external load on the secondaries.

When load is applied to the secondaries the copper loss due to the load current and the triple-frequency current will be equal to the sum of the losses which the two currents would produce separately. For example, in a bank of three 5-kw transformers supplied with voltage having a 5 per cent third harmonic full-load current taken from the bank will produce a copper loss approximately 40 per cent greater than that due to the load current alone.

When transformers are connected Y-delta it is therefore preferable to operate the system without any connection between the generator neutral and the transformer neutral. If the transformer neutral is grounded, the generator neutral should not be grounded, and vice versa. If the generator voltage contains a third harmonic, it may be impossible to operate satisfactorily with the neutrals interconnected.

The explanation of the action above described and the derivation of the formulas used for calculating the third harmonic voltage necessary to produce full-load current are given below.

Theory.—If the generator voltage contains harmonics, the equations of the three phase voltages, e_{01}, e_{02} and e_{03}, may be written:

$$\left.\begin{aligned} e_{01} &= E_1\sin\omega t + E_3\sin(3\omega t - \alpha_3) + E_5\sin(5\omega t - \alpha_5) + \dots\dots\dots\dots\dots\dots\dots \\ e_{02} &= E_1\sin\left(\omega t + \frac{2\pi}{3}\right) + E_3\sin\left(3\omega t - \alpha_3 + 3.\frac{2\pi}{3}\right) + E_5\sin\left(5\omega t - \alpha_5 + 5.\frac{2\pi}{3}\right) + \dots\dots \\ e_{03} &= E_1\sin\left(\omega t - \frac{2\pi}{3}\right) + E_3\sin\left(3\omega t - \alpha_3 - 3.\frac{2\pi}{3}\right) + E_5\sin\left(5\omega t - \alpha_5 - 5.\frac{2\pi}{3}\right) + \dots\dots\dots \end{aligned}\right\} \quad (1)$$

It is to be noted that for the third and multiples of the third harmonic the term corresponding to these harmonics in e_{02} or in e_{03} reduces to the same value as in e_{01}, since the sine of any angle plus or minus a whole multiple of 2π is the same as the sine of the original angle.

It is to be noted also that

$$\sin\left(5\omega t - \alpha_5 \pm 5.\frac{2\pi}{3}\right) = \sin\left(5\omega t - \alpha_5 \mp \frac{2\pi}{3}\right)$$

$$\sin\left(7\omega t - \alpha_7 \pm 7.\frac{2\pi}{3}\right) = \sin\left(7\omega t - \alpha_7 \pm \frac{2\pi}{3}\right), \text{ etc.}$$

Whence the three voltages may be written:

$$\left.\begin{aligned} e_{01} &= E_1\sin\omega t + E_3\sin(3\omega t - \alpha_3) + E_5\sin(5\omega t - \alpha_5) + \dots\dots\dots\dots\dots\dots\dots \\ e_{02} &= E_1\sin\left(\omega t + \frac{2\pi}{3}\right) + E_3\sin(3\omega t - \alpha_3) + E_5\sin\left(5\omega t - \alpha_5 - \frac{2\pi}{3}\right) + \dots\dots\dots\dots \\ e_{03} &= E_1\sin\left(\omega t - \frac{2\pi}{3}\right) + E_3\sin(3\omega t - \alpha_3) + E_5\sin\left(5\omega t - \alpha_5 + \frac{2\pi}{3}\right) + \dots\dots\dots\dots \end{aligned}\right\} \quad (2)$$

The voltages between the terminals of the transformer bank, neglecting the impedance of the connections, are

$$\left.\begin{aligned} e_{ba} &= e_{21} = e_{20} + e_{01} = e_{01} - e_{02} \\ e_{ac} &= e_{13} = e_{10} + e_{03} = e_{03} - e_{01} \\ e_{cb} &= e_{32} = e_{30} + e_{02} = e_{02} - e_{03} \end{aligned}\right\} \quad (3)$$

Substitution in equations (1) gives:

$$\left.\begin{aligned} e_{ba} &= \sqrt{3}\left[E_1\sin\left(\omega t - \frac{\pi}{6}\right) + E_5\sin\left(5\omega t - \alpha_5 + \frac{\pi}{6}\right) + \dots\dots\dots\dots\right] \\ e_{ac} &= \sqrt{3}\left[E_1\sin\left(\omega t - \frac{\pi}{6} - \frac{2\pi}{3}\right) + E_5\sin\left(5\omega t - \alpha_5 + \frac{\pi}{6} + \frac{2\pi}{3}\right) + \dots\dots\dots\dots\right] \\ e_{cb} &= \sqrt{3}\left[E_1\sin\left(\omega t - \frac{\pi}{6} + \frac{2\pi}{3}\right) + E_5\sin\left(5\omega t - \alpha_5 + \frac{\pi}{6} - \frac{2\pi}{3}\right) + \dots\dots\dots\right] \end{aligned}\right\} \quad (4)$$

Hence, when the neutral O of the generator is not connected to the neutral N of the transformer bank, no third or multiple of the third harmonic current can flow, either as an exciting current or as a load current. Therefore no third harmonic or its multiples can be induced in the secondaries, no matter how they may be interconnected, whether in star or in delta.

Next let the neutral O be connected to the neutral N

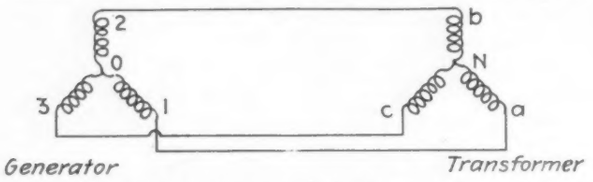


FIG. 1—THREE-PHASE TRANSFORMER BANK WITH PRIMARIES CONNECTED IN STAR

and let the secondaries of the transformer bank be connected in star (Fig. 2) and consider conditions at no load.

Acting around the loop $O2bN$ there will then be a voltage e_{02}, which will produce a current in the transformer bank bN and in the neutral NO equal in effective value to the effective value of e_{02} divided by the open-circuit impedance of the transformer. Similarly, for the loops $O1aN$ and $O3CN$, the voltages acting around these loops will be e_{01} and e_{03} respectively. The currents thus produced in the transformers will, however, be small; in fact, equal only to the normal exciting current of each transformer. In the neutral the resultant current will contain only the third harmonic and its mul-

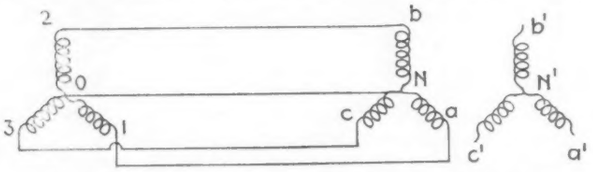


FIG. 2—THREE-PHASE TRANSFORMER BANK WITH SECONDARIES CONNECTED IN STAR

tiples, since the sum of the fundamental currents entering the neutral will be zero, and similarly for the fifth and other harmonics not multiples of the third.

The voltages induced in each of the secondaries of the transformer bank will contain the third harmonic and its multiples, because these harmonics appear in the exciting current. However, these secondaries are Y-connected, and hence the voltage between any pair of terminals, say $b'a'$, will not contain these harmonics, since this voltage is the difference between the voltage from $b'N'$ and the voltage from $a'N'$, and because the third harmonics (and their multiples) in these two voltages are in time-phase.

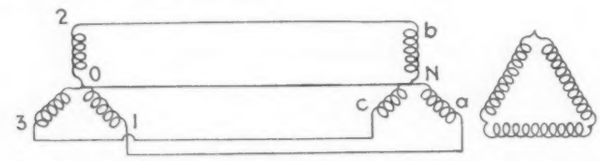


FIG. 3—THREE-PHASE TRANSFORMER BANK WITH SECONDARIES CONNECTED IN DELTA

When the secondaries are delta-connected, as in Fig. 3, with the neutral O connected to N, the third harmonic voltages (and their multiples) induced in the three secondaries will act around the delta in the same direction, since they are in time-phase, and the delta therefore forms a short-circuit to these harmonics. The effective value of the current which will be set up in the transformer by the third harmonic voltages will be equal to the effective value of the third harmonic voltage in any one phase divided by the short-circuit impedance of the transformer to triple-frequency voltage.

Let r be the equivalent resistance of the transformer on short-circuit, and x the equivalent short-circuit reactance at the rated frequency. Then, assuming that x varies directly as the frequency, which is approximately the case, the short-circuit impedance to triple frequency is

$$z_3 = \sqrt{r^2 + (3x)^2}.$$

Let I be the rated full-load current of the transformer and E its rated voltage; then the "per cent resistance" of the transformer is

$$e_r = \frac{100rI}{E}$$

and the "per cent reactance" at the rated frequency is

$$e_x = \frac{100xI}{E}$$

The triple-frequency voltage required to send full-load current through the transformer with the secondary short-circuited, or the triple-frequency voltage required in each transformer to establish full-load current when the connections are as shown in Fig. 3, is then e_3 per cent of the rated voltage, where

$$e_3 = \frac{100z_3I}{E} = \sqrt{\left(\frac{100rI}{E}\right)^2 + \left(\frac{3 \times 100\,xI}{E}\right)^2}$$

or

$$e_3 = \sqrt{e_r^2 + (3e_x)^2}$$

This is the formula used in calculating the table given at the beginning of this article.

Since the delta of the transformers forms a short-circuit to the third harmonic in the voltage wave, this harmonic will not appear in the secondary terminal voltage, and therefore the load current will not contain the third harmonic. The resultant current in the primary of the transformer is

$$I = \sqrt{I_0^2 + I_3^2}$$

where I_0 is the load current (reduced to the primary) and I_3 is the third harmonic current (reduced to the primary) due to the short-circuiting action of the delta. When the triple-frequency current I_3 is equal to the full-load current I_0 the transformer will be overloaded approximately 40 per cent, and the copper loss will be 100 per cent greater than it would be if there were no third harmonic in the impressed voltage.

Continuing Service at Loss Not Compulsory

In the suit brought by the village of Fredonia, N. Y., against the Fredonia Natural Gas Light Company to make the defendant forfeit its special franchise, Judge Pound, of the Supreme Court of Chautauqua County, ruled that the public service company had not improperly suspended the exercise of its rights because it could not furnish gas in competition with others, and that therefore it could not be made to forfeit its franchise (149 N. Y. S., 964). There were no conditions in the franchise, he said, either expressed or implied, which required the company to furnish gas at a loss, and one would have been incurred had the defendant continued to manufacture a supply. Besides, no demands had been made on defendant to furnish gas since it ceased manufacture. Forfeiture is a punishment for fault, not for misfortune. In commenting still further on the case, the judge declared that the village is not injured by the existence of unused pipes in its streets nor will it be by the reopening of streets to lay new pipes. A franchise to do business as distinguished from that to use the streets cannot be forfeited at the suit of the village, but only in action by the State.

A Labor-Saving Transmission-Line Chart

Simplification of the Work Involved in Calculating Voltage Drop on Overhead Alternating-Current System

BY H. B. DWIGHT

THE calculation of the voltage drop for a certain power load is perhaps the most common problem connected with the design of overhead electric power lines. While the calculation is not very difficult, especially for lines of moderate length, it involves a certain amount of labor and the use of line constants for alternating-current lines. It has been found that for estimating purposes this labor can be greatly reduced, and reference to tables practically avoided, by making use of a transmission-line chart. A chart is here presented which is comparatively easy to understand and to use and which is so designed that it applies to loads of leading power-factor as well as lagging power-factor.

Synchronous condensers are being increasingly used with transmission lines as a means of overcoming voltage variation and thereby adding largely to the power rating of the lines. The variations of excitation give rise to problems of line drop over a range extending from zero power-factor lagging to low leading power-factors. For such cases there is need for a line chart of very wide range such as the one herewith shown.

The effect of the capacity of very long lines must be expressed by formulas based on the hyperbolic theory, which generally do not show at a glance the nature of their results. However, it is interesting to note that for lines up to 100 miles in length the effect of capacity can be calculated within 0.1 per cent of line voltage, in the manner shown on the chart, by means of the simple constant K, which is independent of the size or spacing of the conductors. For short lines the regulation—that is, the change in receiver voltage from full load to no load—is the same as the voltage drop along the line, but for long lines the term involving K must be omitted from the expression for voltage drop in order to determine the regulation. In other words, within the limits of the chart, line capacity has no effect on the regulation, since the capacity is present at both no load and full load.

Explanation of Chart

The instructions given on the chart make it practically self-explanatory. A straight-edge is placed across the chart from the point on the left corresponding to the spacing of the conductors to the point on the right corresponding to the resistance of one conductor per mile. The factor, V, is then read directly from the chart for the power-factor of the load considered. This factor is equivalent to the change in received voltage per total ampere per mile of line, due to the line impedance, and by means of it the line drop can be quickly found with a slide-rule according to the formulas on the chart. The line drop is expressed as a percentage of E, the received full-load voltage, according to the usual custom. The drop given by the chart is that due to the line alone and does not include drop due to transformers or reactance coils.

The resistance points for standard conductors marked on the chart are for B. & S. gage (American wire gage) cables at 20 deg. C. (68 deg. Fahr.). The straight-edge may be set to any other values of resistance, and the chart is thus applicable to all kinds of copper and aluminum conductors, except those having a steel core. It is to be noted that for lagging power-factor the lower resistance scale is to be used, and the upper scale for leading power-factor.

The spacing point is to be selected according to whether the frequency is twenty-five cycles or sixty cycles and whether the conductor is copper or aluminum. The spacing points are the same for solid wire or cable. When the conductors of a three-phase line are not equidistant, but are at irregular distances a, b and c apart the effective spacing

$$s = (abc)^{\frac{1}{3}}$$

should be used. With regular flat spacing, where the middle conductor is at a distance a from the outer ones, the effective spacing is simply

$$s = 1.26a.$$

It makes no difference whether the plane of the wires with flat spacing is horizontal, vertical or inclined. The effective spacing of a two-phase line is the mean distance between wires of the same phase.

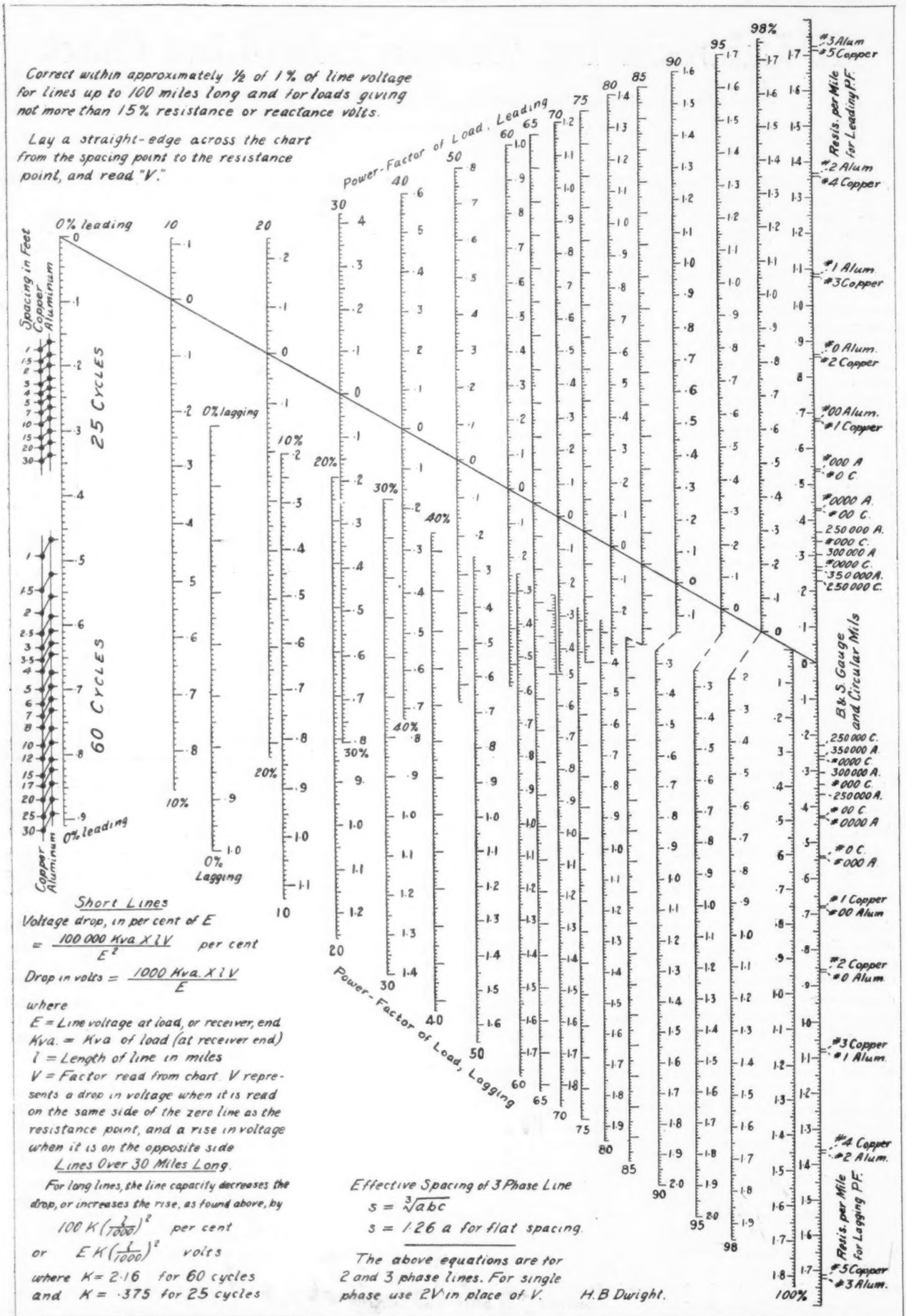
COMPARISON OF CALCULATED WITH CHART VALUES

Conductor (Stranded)	Spacing in Feet	Length of Line in Miles	Phases	Cycles	Kva at Receiver	Voltage at Receiver	Power-Factor, per Cent	Per Cent Drop, by Chart	Per Cent Drop, Calculated	Error in per Cent of Line Voltage
250,000-circ. mil aluminum	12	60	3	60	30,000	100,000	0 lagging	13.8	13.67	+0.2
No. 0 copper	3	15	1	60	300	11,000	50 lagging	6.3	6.40	−0.1
No. 00 aluminum	8 Flat	75	3	25	10,000	88,000	85 lagging	7.1	7.13	−0.1
No. 3 copper	8	100	3	60	3,000	66,000	90 lagging	7.1	7.08	Small
No. 00 aluminum	10	80	3	25	15,000	100,000	95 lagging	8.8	8.81	Small
No. 2 copper	2	8	2	25	2,500	11,000	100 ...	14.4	14.21	+0.2
No. 5 copper	1½	3	3	60	120	2,200	98 leading	12.0	11.78	+0.2
250,000-circ. mil copper	15	100	3	60	25,000	120,000	80 leading	−6.7	−6.45	−0.25
No. 000 copper	1	2	3	60	700	2,200	0 leading	−14.2	−14.22	Small

The problem of finding the size of conductor required for a given load and a given line drop is the converse to the problem discussed above of finding the voltage drop of a given line. A direct solution of this converse problem cannot be obtained by any of the usual methods of calculation. Hence it is an important advantage of the chart that it solves directly this useful problem. First, V is calculated by means of the formulas on the chart, and then a straight-edge is placed through V and the point for the spacing to be used, and the required size of conductor can be seen at a glance on the resistance scale at the right.

The accuracy of the chart is given as approximately 0.5 per cent of the line voltage when the load is not large enough to produce more than 15 per cent resistance or reactance volts. It is easy to test whether this condition is met, by finding the percentage drop with the same kva load, at 100 per cent power-factor for the approximate resistance volts, and at zero power-factor lagging for the reactance volts.

The chart printed on the next page should be judged by its convenience in use and by its accuracy for usual problems. In order to assist in determining whether


Correct within approximately ½ of 1% of line voltage for lines up to 100 miles long and for loads giving not more than 15% resistance or reactance volts.
Lay a straight-edge across the chart from the spacing point to the resistance point, and read "V."
Spacing in Feet
Copper
Aluminum
25 Cycles
60 Cycles
0% leading
0% lagging
10%
20%
30%
40%
Power-Factor of Load, Leading
Power-Factor of Load, Lagging
Resis. per Mile for Leading P.F.
Resis. per Mile for Lagging P.F.
B & S. Gauge and Circular Mils
#3 Alum #5 Copper
#2 Alum #4 Copper
#1 Alum #3 Copper
#0 Alum #2 Copper
#00 Alum #1 Copper
#000 A #0 C.
#0000 A #00 C.
250 000 A #000 C.
300 000 A #0000 C.
350 000 A 250 000 C.
250 000 C. 350 000 A
#0000 C. 300 000 A
#000 C. 250 000 A.
#00 C. #0000 A
#0 C. #000 A
#1 Copper #00 Alum
#2 Copper #0 Alum
#3 Copper #1 Alum
#4 Copper #2 Alum.
#5 Copper #3 Alum.
98%
100%

Short Lines

Voltage drop, in per cent of E

$$= \frac{100\,000 \text{ Kva} \times l \times V}{E^2} \text{ per cent}$$

$$\text{Drop in volts} = \frac{1000 \text{ Kva.} \times l \times V}{E}$$

where

E = Line voltage at load, or receiver, end.
Kva. = Kva of load (at receiver end)
l = Length of line in miles
V = Factor read from chart. V represents a drop in voltage when it is read on the same side of the zero line as the resistance point, and a rise in voltage when it is on the opposite side

Lines Over 30 Miles Long.

For long lines, the line capacity decreases the drop, or increases the rise, as found above, by

$$100\,K\left(\frac{l}{1000}\right)^2 \text{ per cent}$$

or

$$E\,K\left(\frac{l}{1000}\right)^2 \text{ volts}$$

where K = 2.16 for 60 cycles
and K = .375 for 25 cycles

Effective Spacing of 3 Phase Line

$$s = \sqrt[3]{abc}$$

$$s = 1.26\,a \text{ for flat spacing.}$$

The above equations are for 2 and 3 phase lines. For single phase use 2V in place of V.

H. B Dwight.

CHART FOR VOLTAGE DROP OF ALTERNATING-CURRENT TRANSMISSION AND DISTRIBUTION LINES

the chart is useful for a given class of work, an example is worked out in detail, and the results of a number of problems are tabulated, with the percentages of error due to the chart.

Problem.—Find the voltage drop for the following line: Length of line, 100 miles; conductor, No. 00 B. & S. copper cable; spacing, 8 ft.; load (measured at receiver end), 6000 kva, 60,000 volts, 85 per cent power-factor, lagging, three-phase, sixty cycles.

Lay a straight-edge from the 8-ft. spacing point for sixty cycles, copper conductor, to the point on the lower resistance scale for No. 00 copper cable. It is found to cross the 85 per cent power-factor line at the reading 0.78, and since it is on the same side of the zero line as the resistance point used, it represents a drop in voltage.

Then the per cent drop

$$= \frac{100{,}000 \times 6000 \times 100 \times 0.78}{60{,}000 \times 60{,}000} - 100 \times \frac{2.16}{100}$$

$= 13.0 - 2.16$

$= 10.8$ per cent approximately.

The voltage drop, calculated according to the hyperbolic theory of transmission lines, is 10.99 per cent, and hence the error involved in using the chart is 0.2 per cent of the line voltage, which is less than the stated limit of error.

CENSUS OF MUNICIPAL PLANTS

Although City-Owned Plants Comprise 29.9 Per Cent of the Total Central Stations in Number, Their Gross Earnings Are Only 7.7 Per Cent of the Total

The returns of the Bureau of the Census from electric central stations for 1912, which are in course of preparation for publication, show the relative development of commercial and municipal plants.

As indicated in the statistics published in the ELECTRICAL WORLD of March 14, 1914, the number of commercial stations is 3659, as compared with 1562 municipal plants. These figures, however, are not indicative of the relative importance of the two classes of plants. While the number of commercial stations was 70.1 per cent of the total number of plants, the gross income of the commercial stations was 92.3 per cent of the total income of all stations. The municipal plants, comprising 29.9 per cent of the total number of plants, earned but 7.7 per cent of the total gross earned by both classes of plants. The difference in the actual figures of earnings is shown by the fact that of the total income of $302,115,599 in 1912 commercial stations had $278,896,610 as compared with the municipal plant income of $23,218,989. The municipal plants had 18.2 per cent of the estimated number of arc lamps wired for service as compared with 81.8 per cent for commercial stations, showing the large extent to which the municipal plants are used for street-lighting purposes. Table I, published herewith, shows the totals for a number of items embraced in the census, divided between the two classes of stations.

The groupings of States in the census report are as follows:

North Atlantic Division: New England—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut; Middle Atlantic—New York, New Jersey and Pennsylvania.

South Atlantic Division: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia and Florida.

North Central Division: East North Central—Ohio, Indiana, Illinois, Michigan and Wisconsin; West North Central—Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska and Kansas.

South Central Division: East South Central—Kentucky, Tennessee, Alabama and Mississippi; West South Central—Arkansas, Louisiana, Oklahoma and Texas.

Western Division: Mountain—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah and Nevada; Pacific—Washington, Oregon and California.

The change in the relative position of commercial and municipal stations is shown by Table II. This indicates that the commercial stations comprised a smaller percentage of the total stations in 1912 than in either 1907 or 1902 and, conversely, that the municipal stations comprised a larger percentage of the total in 1912 than in either 1907 or 1902. Slight though the changes in the relative proportion of gross income of the two classes of stations are, the commercial stations have increased their proportion of the total while the municipal stations have decreased. The commercial stations furnished a slightly higher percentage of the total income in 1912 than in either 1907 or 1902. In 1912 there were 310 more municipal central stations than in 1907. From 1907 to 1912 301 new municipal central stations were started; 106 commercial stations became municipal; 80 central stations that were munic-

TABLE I—STATISTICS FOR COMMERCIAL AND MUNICIPAL ELECTRIC CENTRAL STATIONS

	Commercial Stations	Municipal Stations	PER CENT OF TOTAL	
			Commercial	Municipal
Number of stations	3,659	1,562	70.1	29.9
Total income	$278,896,610	$23,218,989	92.3	7.7
Light, heat and power, including free service	$264,317,150	$22,663,708	92.1	7.9
All other sources	$14,579,460	$555,281	96.3	3.7
Total expenses, including salaries and wages*	$217,502,313	$16,917,165	92.8	7.2
Total number of persons employed	71,395	7,940	90.0	10.0
Total horse-power	6,969,320	559,328	92.6	7.4
Steam engines and steam turbines—				
Number	5,820	2,024	74.2	25.8
Horse-power	4,539,866	406,666	91.8	8.2
Waterwheels—				
Number	2,664	269	90.8	9.2
Horse-power	2,340,820	130,261	94.7	5.3
Gas and oil engines—				
Number	833	283	74.6	25.4
Horse-power	88,634	22,401	79.8	20.2
Kilowatt capacity of dynamos	4,766,012	368,677	92.8	7.2
Output of stations, kilowatt-hours	10,995,436,276	537,526,730	95.3	4.7
Estimated number of lamps wired for service:				
Arc	413,544	91,851	81.8	18.2
Incandescent and other varieties	69,449,293	7,057,849	90.8	9.2
Stationary motors served:				
Number	413,578	21,895	95.0	5.0
Horse-power capacity	3,966,328	164,291	96.0	4.0

*In addition to salaries and wages, includes the cost of supplies and materials used for ordinary repairs and replacement, advertising, fuel, mechanical power, electrical energy purchased, taxes, charges for depreciation and charges for sinking fund, and all other expenses incident to operation and maintenance.

TABLE II—PERCENTAGES OF TOTAL FURNISHED BY COMMERCIAL AND MUNICIPAL PLANTS

	COMMERCIAL			MUNICIPAL		
	1912	1907	1902	1912	1907	1902
Number of stations	70.1	73.4	77.5	29.9	26.6	22.5
Total income	92.3	92.0	91.9	7.7	8.0	8.1
Light, heat, and power, including free service	92.1	92.0	91.9	7.9	8.0	8.1
All other sources	96.3	93.4	91.5	3.7	6.6	8.5
Total expenses, including salaries and wages	92.8	92.3	92.3	7.2	7.7	7.7
Total number of persons employed	90.0	88.3	88.7	10.0	11.7	11.3
Total horse-power	92.6	92.2	91.3	7.4	7.8	8.7
Steam engines and steam turbines	91.8	89.4	89.4	8.2	10.6	10.6
Waterwheels	94.7	97.8	97.4	5.3	2.2	2.6
Gas and oil engines	79.8	89.1	92.1	20.2	10.9	7.9
Kilowatt capacity of dynamos	92.8	92.3	90.6	7.2	7.7	9.4
Output of stations, kilowatt-hours	95.3	95.1	92.2	4.7	4.9	7.8
Estimated number of lamps wired for service:						
Arc	81.8	85.2	86.8	18.2	14.8	13.2
Incandescent and other varieties	90.8	90.2	91.3	9.2	9.8	8.7
Stationary motors served:						
Number	95.0	97.3	98.1	5.0	2.7	1.9
Horse-power capacity	96.0	98.1	99.2	4.0	1.9	0.8

ipal in 1907 became commercial in 1912; there were 17 active municipal stations in 1907 that were out of business or not operated in 1912. Of the increase of 310 in municipal central-station plants, 125 were in the West North Central group of States. In the group of States classified as the East North Central, West North Central, East South Central and West South Central, comprising a total of twenty States, there were 230 new municipal central stations in 1912 as compared with 1907. The smallest number of new municipal central stations in any of the groups of States was three in the Middle Atlantic States.

Table III, taken from one of the tables in the census returns, shows the development of municipal stations by the population of the cities in which such stations are situated and by geographic divisions in 1912. Of the 1562 municipal central electric stations 1327 were in cities of less than 5000 population. Only eight were in cities of 500,000 population or more. While there was an increase in the number of central stations in each group of the cities as they are classified in the census returns, the largest increase was in communities of under 5000. The increase in the number of municipal stations in the communities of the small size named was 97.8 per cent in ten years. The municipal stations in the cities which are covered by Table III reported in 1912 47.5 per cent of the total income, 46 per cent of the primary power, 46.8 per cent of the total kilowatt capacity of dynamos, 34.7 per cent of the output of stations, 25.1 per cent of the arc lamps and 55.2 per cent of the incandescent lamps. In each case these proportions are considerably less than the corresponding percentages for 1907 and 1902. The North Central group of States contained 873 of the municipal stations, or 55.9 per cent of the total reported.

TABLE III—MUNICIPAL CENTRAL ELECTRIC STATIONS, BY POPULATION OF CITIES IN WHICH THEY ARE SITUATED AND BY GEOGRAPHIC DIVISIONS

Division and Population Group	Census	Number of Stations	Cost of Construction and Equipment	Annual Income			Total Expenses, Annual	Total Primary Horse-Power	Kilowatt Rating of Dynamos			Annual Output of Stations, Kw-hr.	Estimated Number of Lamps Wired for Service	
				Tota	Electric Service	All Other Sources			Total	Direct-Current, Constant Voltage and Amperage	Alternating and Polyphase Current		Arc	Incandescent and All Other Varieties
Total	1912	1,562	$77,065,144	$23,218,989	$22,663,708	$555,281	$16,917,165	559,328	363,677	44,564	324,113	537,526,730	91,851	7,057,849
	1907	1,252	42,879,447	14,011,999	13,614,434	397,565	9,167,188	321,351	209,016	45,993	163,023	289,462,788	82,940	4,061,318
	1902	815	22,020,473	6,965,195	6,836,856	128,249	4,741,182	169,028	113,389	45,727	67,653	195,904,439	59,795	1,577,451
Under 5,000	1912	1,327	31,349,806	11,026,579	10,678,780	347,799	8,412,993	257,384	172,705	25,803	146,902	186,294,678	23,060	3,895,703
5,000 but under 25,000	1912	189	15,953,305	6,014,722	5,861,287	153,435	4,103,721	128,506	91,696	7,030	84,666	127,432,560	19,976	2,010,446
25,000 but under 100,000	1912	31	8,304,604	2,822,984	2,792,212	30,772	2,032,825	91,327	62,341	2,371	59,970	65,838,060	15,537	652,059
100,000 but under 500,000	1912	7	8,559,566	1,584,082	1,575,596	8,486	1,095,607	47,255	27,064	844	26,220	61,120,808	12,576	368,118
500,000 and over	1912	8	12,897,863	1,770,622	1,755,833	14,789	1,272,019	34,856	14,871	8,516	6,355	96,840,624	20,693	131,523
North Atlantic	1912	159	9,616,877	3,226,157	3,136,497	89,669	2,475,596	77,698	54,031	5,055	48,976	68,625,617	11,704	1,052,379
South Atlantic	1912	204	7,134,097	2,851,941	2,827,057	24,884	2,045,927	66,845	45,063	1,717	43,346	49,325,343	8,192	853,837
North Central	1912	873	42,212,002	11,656,482	11,314,999	341,483	3,589,329	265,159	176,389	33,419	142,961	309,367,765	59,629	3,625,088
South Central	1912	250	8,256,749	2,870,011	2,831,077	38,934	2,089,541	67,576	44,645	4,146	40,499	54,562,006	7,898	653,383
Western	1912	76	9,845,419	2,614,393	2,554,078	60,329	1,725,862	82,059	48,558	227	48,331	55,645,999	4,437	873,162

Great Extent of Progress

Table IV shows the development per 1000 population for the United States as a whole and the division according to the census groupings of States. The great extent of the progress is indicated by the fact that where the number of incandescent lamps per 1000 of population was 232 in 1902 and had increased to 485 in 1907, it was 800 in 1912. The progress in some States was much greater during the decade than these figures indicate; for instance, the South Central and South Atlantic groups increased from 70 to 57 respectively in 1902 to 304 and 309 respectively in 1912. The largest proportion of incandescent lamps held in any of the groups of States is in the Western States, which reported an average of 1.3 lamps per inhabitant. The North Atlantic States were a little below this average, having an average of 1.1 per inhabitant.

Western States Ahead in Ratings

The Western States were far ahead in horse-power rating of engine and waterwheels and kilowatt rating of dynamos per 1000 population. The most highly developed sections of the country show the largest number of central electric stations. The North Atlantic and North Central divisions of States, which represented 60.3 per cent of the estimated population in 1912, reported 67 per cent of the total primary horse-power in that year and 67.7 per cent of the total kilowatt rating of dynamos. The Western division, which had 7.8 per cent of the population in 1912, had 18.8 per cent of the primary horse-power and 18.3 per cent of the kilowatt rating of dynamos. The Western division of States, which had 7.8 per cent of the total population in 1912, was third in all the main factors of central-station equipment and first in all of the proportions shown per 1000 of population except for arc lamps, in which it was third. The number of arc lamps per 1000 of population, which was 4.9 for the entire United States for 1902 and had increased to 6.5 in 1907, decreased to 5.3 in 1912.

TABLE IV—CENTRAL ELECTRIC STATIONS—RELATION OF LEADING ITEMS TO POPULATION, BY GEOGRAPHIC DIVISIONS—PER 1000 POPULATION

Division	Census	Horse-Power of Engines and Waterwheels*	Kilowatt Rating of Dynamos	Output of Stations, Kw-hr.	Lamps†	
					Arc	Incandescent
United States	1912	79	54	129,737	5.3	800
	1907	48	32	68,538	6.5	435
	1902	23	15	31,936	4.9	232
North Atlantic	1912	102	70	164,319	8.4	1115
South Atlantic	1912	49	33	54,014	1.7	309
North Central	1912	75	52	105,612	5.8	877
South Central	1912	25	17	25,802	2.1	304
Western	1912	191	126	366,134	5.5	1371

*Includes capacity of auxiliary engines, amounting to 65,823 hp in 1907 and 14,454 hp in 1902.

†Exclusive of "other varieties", Nernst, vacuum, vapor, etc., 23,046 in 1912, and 162,338 in 1907; also exclusive of 275,079 lamps in 1907 used by the central stations to light their own properties, these lamps being included in 1912 and 1902, though not separately reported.

SHORT-CIRCUITS AND THEIR PREVENTION

Abstract of Paper Presented Before the A. I. E. E. at New York and of the Discussion Thereon

The effect of short-circuits on the heating of and on the mechanical forces between conductors, together with the advantages or disadvantages of placing reactors in different circuits, were discussed in a paper entitled "Theoretical Investigation of Electric Transmission Systems Under Short-Circuit Conditions," presented by Mr. I. W. Gross, on Jan. 8, before a meeting of the American Institute of Electrical Engineers in New York. The resultant force acting on each conductor of a three-phase cable when all three legs are simultaneously short-circuited was expressed by the formula

$$F_o = -\frac{4.67I^2 10^{-7}}{a \text{ (inches)}}$$

F_o is expressed in pounds per foot when I is the current per phase expressed in the root-mean-square value and a is the distance between conductors in inches. The negative sign indicates that the force is repulsion. By substituting values in this formula it can be seen that with a cable in which the conductors are 0.9 in. apart a force of 208 lb. per ft. would be exerted upon each conductor if 20,000 amp per phase is flowing, while 5200 lb. per ft. is exerted with a current of 100,000 amp. Three-phase busbars arranged in a triangular manner and subjected to a three-phase short-circuit may therefore exert excessive stresses on the insulating supports. In a system where the short-circuit current per phase is limited to a definite value for three-phase short-circuits the current per phase on a single-phase short-circuit will be 13.4 per cent less; therefore the mechanical force acting on the conductors will be only 86.6 per cent of that indicated by the formula just given. In other words, a three-phase short-circuit at a given point in a system will subject the conductors to 15.5 per cent greater stresses than a single-phase short-circuit at the same point. If the three conductors of a three-phase circuit are arranged in the same plane, the average forces acting on the outer conductors will be only 86.6 per cent of those acting with the conductors separated by the same distance but arranged at the vertices of an equilateral triangle.

A short-circuit in a conductor develops a considerable amount of heat in a short time, and as radiation requires time only a brief interval need elapse to permit the temperature to rise sufficiently to injure the cable insulation or even melt the conductor itself. Curves were shown to indicate the temperature rise in a No. 000 cable under short-circuit conditions producing currents from 20,000 amp to 60,000 amp after small fractions of a second had elapsed. One set of curves was plotted with the assumption that the current was symmetrical with respect to the axis of reference, while the other curves were plotted for an unsymmetrical current wave. From these curves the author came to the conclusion that an oil switch opening 0.18 second after the short-circuit has occurred will prevent melting of the conductors but may not prevent injury to the cable insulation unless the maximum current is limited. It was shown that an unsymmetrical current wave may cause from one and two-fifths to two and one-half times the temperature rise that a symmetrical current wave will cause. Attention was also called to the fact that for any given current, material and radiation the temperature rise is inversely proportional to the square of the conductor cross-section.

Several methods of employing reactors to limit short-circuit currents were referred to, the characteristics of the system suggested by Mr. H. G. Stott at the last midwinter convention of the A. I. E. E. being discussed at length. The arrangement of reactors is illustrated in the accompanying diagram. The conclusion was drawn that the synchronizing reactors will have more effect in reducing short-circuit currents if the feeder-bus reactance is comparatively low. When the latter reaches 5 per cent or more the effectiveness of the synchronizing reactors in further reducing current becomes practically negligible. It was also pointed out that if the synchronizing reactor is not used the feeder-bus reactor will rapidly lose its effectiveness after 5 per cent is reached. For reducing short-circuits beyond the oil switches it is not necessary for the synchronizing reactors to have a reactance exceeding 3 per cent, and when the generators have high inherent reactance the synchronizing reactance need not be over 1 per cent. The accompanying curves show the ratio required between the synchronizing reactance and the inherent reactance of the generators to limit the synchronizing current to the normal short-circuit output of the machine. Among advantages ascribed to the system suggested by Mr. Stott are: The feeder-bus voltages are little affected by short-circuit on one of them; all generators can deliver energy to a single feeder bus without a considerable drop in voltage; the machines

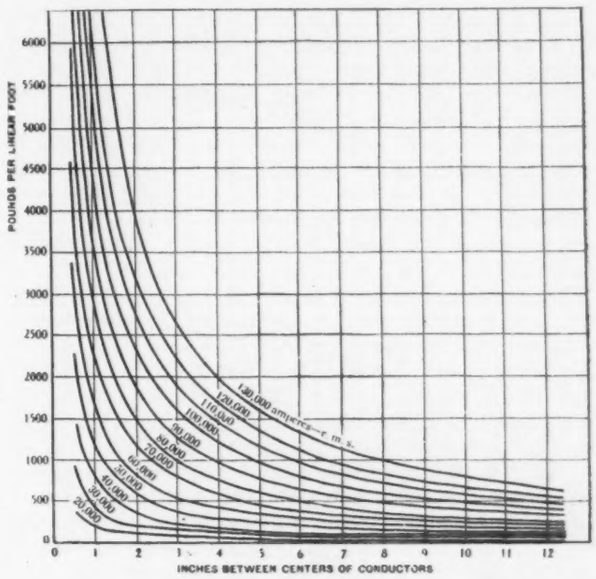


FIG. 1—REPULSIVE FORCE BETWEEN CONDUCTORS IN SHORT-CIRCUITED THREE-PHASE CABLE

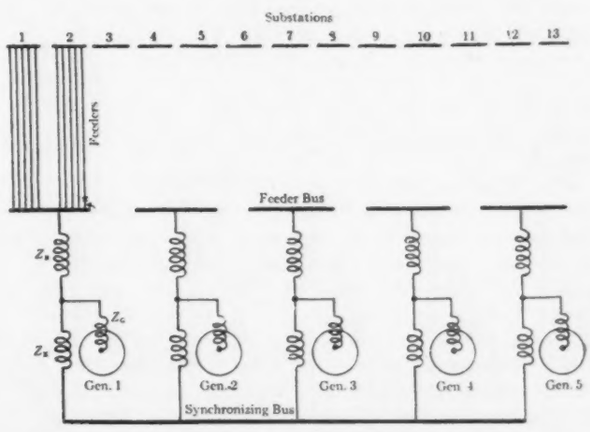


FIG. 2—FEEDER BUS AND SYNCHRONIZING REACTORS

are not easily pulled out of step by short-circuit, and with a short-circuit on the bus an excessive flow of current to the fault is prevented by reactors. When feeder reactors are employed short-circuit troubles are isolated. Busbar reactors reduce short-circuit currents between bus sections but introduce considerable reactance to generators supplying other than their own

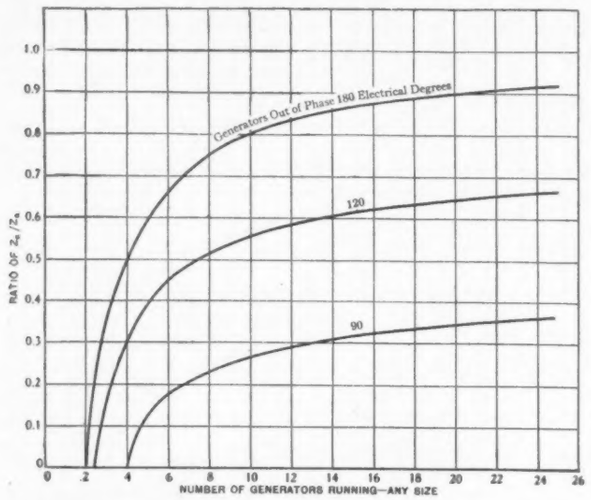


FIG. 3—CONDITIONS FOR PROTECTING AGAINST POOR SYNCHRONIZING

buses, thereby producing a voltage drop. If the short-circuit current in a feeder is to be limited to a low value it is impracticable to interconnect substation feeders.

Discussion

In the discussion of the paper abstracted in the foregoing paragraphs particular attention was paid to the advantages and disadvantages of different arrangements of reactors. Among those taking part in the discussion were Messrs. H. G. Stott, Philip Torchio, C. M. Davis, H. R. Woodrow, James Lyman, J. B. Taylor, R. W. Atkinson, C. L. G. Fortescue and Hans Lippelt.

Mr. Stott described conditions which led the Interborough Rapid Transit Company, New York City, to adopt the arrangement of reactors shown in the accompanying diagram. He inferred that to obtain equal protection during a short-circuit the use of feeder reactors is more expensive and requires more space than reactors arranged as shown. He also declared that busbar reactors make voltage regulation extremely difficult.

Mr. Torchio referred briefly to a lock for holding disconnecting switches closed under short-circuit conditions and spoke more extensively on the advantages of feeder reactors. He called attention to the small amount of space occupied by the 3.5 per cent reactors which are being installed in the sixty-cycle feeders at the generating station of the United Electric Light & Power Company, New York City. Figures were given for a system in which the feeders were paralleled to show that for the same expense feeder reactors can be installed which will limit the short-circuit current to a smaller value than reactors arranged according to Mr. Stott's plan. The speaker also stated that experience has shown that reactors have never caused trouble by producing resonance. He outlined the system in Berlin, where the substations are operated independently, so that any trouble arising in one district will be confined to that district and not affect the entire city.

Mr. Davis called attention to the number of approximations which must be employed in preparing a paper like that of Mr. Gross, and also gave a list of assumptions which have to be made. He expressed the belief that Mr. Stott's arrangement of reactors would give greater protection than feeder reactors. He pointed out that in analyzing short-circuit conditions too many have confined their attention to the energy which could be supplied from the generator end without taking into account the energy which could be fed back from the substations. The speaker also explained the use of two formulas for estimating the temperature rise in cables by much simpler methods than those described in Mr. Gross' paper.

Mr. Woodrow pointed out that only large and expensive oil switches are capable of breaking a current of 36,800 amp at 11,000 volts, and hence a further reduction of the maximum short-circuit current is often warranted to permit the installation of a cheaper and smaller switch. He also pointed out that the maximum forces exerted on conductors during short-circuit are about twice the average value. The speaker declared further that it is impossible to have maximum asymmetrical currents in all three phases during a three-phase short-circuit and hence the forces produced by single-phase short-circuit in a given circuit may be more severe than with a corresponding three-phase short-circuit. Rearrangement of buses will therefore not always reduce the maximum stresses, although the direction of the force may be changed to reduce the strain on the insulators. Mr. Woodrow declared that paralleling substations will not produce so marked an effect on the short-circuit current in a feeder as held in Mr. Gross' paper.

Mr. Taylor insisted that it is necessary to include the temperature-resistance coefficient in the formula for the temperature rise of cables on short-circuits unless the temperature is prevented from rising above 100 deg. C.

Mr. Atkinson declared that the maximum forces exerted on conductors carrying asymmetrical short-circuit current waves are somewhat more than four times the value expressed by the formula in Mr. Gross' paper. He said that on examining the insulation of a No. 8 cable which had been subjected to a current which melted it in about four seconds it was found that only one or two layers of paper next to the conductor were charred, while all the rest were apparently unaffected. If the copper had been heated for a longer time prior to fusing, enough gas might have been formed by charring of the paper to cause the destruction of the lead cover.

Mr. Fortescue said that as short-circuits are more frequent in feeders than on station busbars more attention should be paid to protecting the former than the latter. He expressed the belief that a combination of feeder reactors with the arrangement evolved by Mr. Stott would have distinct advantage over either arrangement used alone.

Mr. Lippelt said that many difficulties could be overcome by employing high-voltage direct-current instead of alternating-current energy. For protection against short-circuits on a direct-current system he suggested employing iron-core reactors in combination with relays which would insert current-limiting resistance in the circuit before the short-circuit current reached an excessive value.

In closing the discussion Mr. Gross expressed the belief that iron-core reactors would not be effective in delaying excessive increases in current in a direct-current system even if designed to operate at low flux density on normal loads as a short-circuit would quickly saturate the core, thereby decreasing the effectiveness of the coil.

DIGEST OF ELECTRICAL LITERATURE

Generators, Motors and Transformers

Speed Reduction of Induction Motors.—A. WINKLER.—An English translation in abstract of his German article, noticed some time ago in the Digest, in which the problem of regulating the speed of induction motors driving ventilating fans by means of slip resistance is discussed, and the loss entailed thereby ascertained. It is found that this method is often preferable to the use of variable-speed sets.—London *Electrician*, Dec. 25, 1914.

Generation, Transmission and Distribution

Automatic Protective Switch Gear for Alternating-Current Systems.—E. B. WEDMORE.—An illustrated paper in abstract read before the (British) Institution of Electrical Engineers. The author concludes that to meet all the ordinary and emergency requirements of electric supply there are now available a series of devices simple in character, well proved in service and giving a degree of protection hitherto quite unattainable. The series is as follows: (a) For the protection of all closed feeder circuits, the split-conductor system; (b) for the protection of all open-ended feeder circuits, including individual motor circuits, isolated transformers, rotary converters and the like, the core-balancing system; (c) for the protection of generators and banks of transformers, the circulating-current system.—London *Electrician*, Dec. 11, 1914. An account of the discussion which followed the paper is given in London *Electrician*, Dec. 18, 1914.

Individual Motor Versus Group Driving.—KARL LOSS.—A brief mathematical article on the efficiency of individual-motor driving and group driving, with consideration of the period for which the machines are in actual operation. The general result is that each case must be considered for itself. For machines which require a high starting torque and no wide speed regulation induction motors are more favorable and may be the only permissible ones for individual motor driving. For machines which require speed regulation within wide limits direct-current motors are preferable. But three-phase commutator motors are now being built for large capacity, permitting speed regulation at constant torque and having otherwise advantages over induction motors.—*Elek. u. Masch.* (Vienna), Nov. 29, 1914.

Electrical Driving in the Woolen Trade—J. F. CROWLEY.—An abstract of a paper read before the Halifax Textile Society in which the author discusses the suitability of electric driving in the woolen trade and the advantages and disadvantages of groups and of individual driving. The driving of looms, mules and centrifugals is considered in turn.—London *Electrician*, Dec. 18, 1914.

Electric Power in Printing Office.—FRANK BROADBENT.—An illustrated abstract of that part of his paper read before the (British) Association of Engineers-in-Charge which deals with the use of electric power in the printing office and discusses individual or group driving, the best type of motor to use, the best method of driving, the switch gear, rotary newspaper machines, single-motor diverter control, two-motor equipment, variable voltage control, etc.—London *Engineering*, Dec. 18, 1914.

Installations, Systems and Appliances

Stockholm Investigation on Electric Heating.—CARL A. ROSSANDER.—The central station of Stockholm, Sweden, is a steam plant, but a hydroelectric plant is in course of erection at the Dalälven River from which energy will be transmitted to Stockholm. The steam plant will then be used for furnishing the peak load and as a reserve. A commission was appointed to investigate the economy of electric heating of houses and of the new Stockholm city hall. Comparative tests were made in the office rooms of the building department in the new city hall as to the cost of heating with fuel and of electric heating, the temperature of the rooms being maintained constant at 18 deg. C. For six months the suite of offices was heated alternately one week by means of a fuel-fired hot-water system and the next week by an electric heating system. The amount of coke used was measured as well as the electrical energy. Electric heating was carried out in two different ways. The electric-heating system was either connected to the circuit during the whole twenty-four hours of the day or it was disconnected after 5 p. m. when the offices were closed and the circuit was closed again at 7 a. m. With the latter method the temperature of the rooms decreased considerably during the night, but with the exception of a few very cold days the temperature had reached again the correct value at 9 a. m. With the continuous electric-heating system the same heating effect was obtained with 198 kw-hr. as with 100 liters (2½ bushels) of coke for the hot-water system. With the intermittent electric-heating system the same heating effect was obtained with 120 kw-hr. as with 100 liters (2½ bushels) of coke. Therefore, if the condition of the case permits the use of the intermittent heating system it should be used, as it means a saving of 40 per cent of electrical energy. The second problem discussed by the commission was how high a rate it would be possible to pay for electric energy if electric heating were not more expensive than hot-water heating. At the time of the test the coke sold at the high price of 28 cents per 100 liters (2½ bushels), so that with the continuous electric-heating system the economic limit of the price of the kilowatt-hour would be 0.25 cent and for the intermittent electric-heating system 0.425 cent. These figures prove that even with hydroelectric energy electric heating of houses can be seriously considered only in cases in which there is a large excess of energy which cannot be used otherwise, and in such cases some system of storage of heat should be used. For the local conditions of Stockholm the cost of electric heating is prohibitive.—*Elek. Zeit.*, Dec. 3, 1914.

British Central Station.—The first parts of an illustrated description of recent extensions at the Lister Drive municipal electric station in Liverpool. A new 7500-kva turbo-generator set has been installed which brings the capacity up to 17,000 kw, but this is to be raised in the near future to 35,000 kw. The new generator has a normal full-load output of 7500 kva at 80 per cent power-factor, 16,600 volts, the frequency being fifty cycles per second.—London *Electrician*, Dec. 18 and 25, 1914.

Switching Phenomena.—W. LINKE.—An illustrated English translation in abstract of his German paper, noticed some time ago in the Digest, on switching phenomena in connection with electric machines and transformers.—London *Electrician*, Dec. 25, 1914.

Wires, Wiring and Conduits

Determining the Load in Branch Distribution Circuits of Direct-Current Systems.—L. LEWIN.—In distribution systems it becomes often important to measure the load in a branch circuit without interrupting the service. For this purpose the author uses a simple method in which, with only a millivoltmeter without a shunt (but perhaps with a small series resistance), it

is possible to determine the intensity and direction of the currents in the different conductors branching off from a distribution point. The fuse inserted in each of the circuits is used in his method as the shunt for the millivoltmeter. The method is based on the fact that in a large cable network only a comparatively limited number of types of fuses are employed. In a

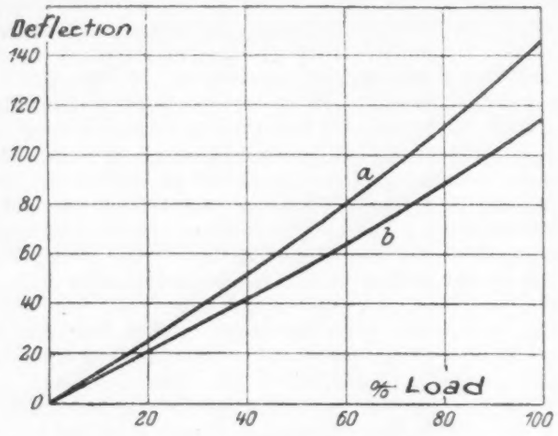


FIG. 1—CALIBRATION CURVES

city network of 220 volts, for instance, most distribution lines (50 to 70 sq. mm cross-section) are protected by fuses rated at 200 amp, while a number of the circuits (95 to 150 sq. mm) are protected by 300-amp fuses. When the different types of fuses (silver, lead and alloys) are considered there are usually not more than eight or ten different types. In order to use the fuses as shunts to the millivoltmeter, they should be calibrated for this instrument, and the author determined how nearly uniform different samples of one type of fuse are. The uniformity was satisfactory as shown by a test of a number of fuses in series. Out of this number one fuse was then selected which was nearest the average value, and for this fuse the calibration curve was determined. A constant current was then passed through the fuse with a millivoltmeter connected to its terminals, and after ten minutes the reading of the millivoltmeter was taken. The current was then raised to a high value and maintained constant again for about ten minutes, and another reading was taken. In this way a curve was plotted giving the deflection of the millivoltmeter as a function to the current (or, expressed in other words, as a percentage of the maximum current rating or as a percentage of the load). Fig. 1 gives two calibration curves of this kind. Curve *a* refers to a 100-amp "britannia" alloy fuse and curve *b* to a 200-amp silver-wire fuse. While deflections of the instrument are a little different with increasing and decreasing load, it is generally possible to figure on an error of not more than 5 per cent. If it is desired to get very exact results, the following method may be used: At the time of maximum load the cable box is opened and the millivoltmeter is connected to the terminals of the fuse in the circuit to be tested and the rating of the millivoltmeter is taken. On the next day, at a time when the load is low, the fuse is taken from the cable box and tested in the testing room with a current so as to give the same deflection at the millivoltmeter that was obtained the day before. This gives almost as high an accuracy as a precision instrument. This method may also be used in the case of a fuse for which no calibration curve is available. With proper modifications this method may be used for determining the load distribution in three-wire and polyphase networks and for determining faults.—*Elek. Zeit.*, Dec. 3, 1914.

Electrophysics and Magnetism

Production of High Permeability in Iron.—A note on a recent Royal Society paper by Prof. Ernest Wilson, dealing with some further investigations on the production of high permeability in iron. It had been shown that if stalloy in laminated-ring form was subjected to a magetizing force due to a direct current while it was cooling through the temperature at which it regained its magnetic properties, and was at the same time shielded from the influence of the earth's magnetism, the permeability recovered at atmospheric temperature had a maximum value of over 10,000 when the magnetic induction was of the order 6000 c.g.s. units. It had been shown previously that high values of the permeability could be obtained without the use of a special magnetizing force, due to an alternating current, during the time that it cooled through the temperature at which it regained its magnetic properties. As, however, in the last-mentioned case an iron tube was used to inclose the specimen and became heated with the specimen, it was thought desirable to discover whether the high value of the permeability could be obtained when there was no question of magnetic shielding. In the present experiments the specimen of stalloy in ring form was allowed to cool inside a sealed fire-clay crucible, when subjected to a magnetizing force of 13 c.g.s. units, and at atmospheric temperature a permeability of over 10,000 was again obtained. Further experiments had been made with stalloy in the form of straight strips. The specimen, which consisted of a number of strips side by side, was wound with a magnetizing coil and then placed inside an iron tube. On allowing it to cool through the temperature at which the magnetic quality was regained, when subjected to a magnetizing force due to a direct current, the improvement in maximum permeability when at atmospheric temperature was small, and it had apparently disappeared when re-tested at the maker's works.—London *Electrician*, Dec. 11, 1914.

Hall Effect in Silicon.—O. E. BUCKLEY.—An account of an experimental investigation in which the Hall effect, Nernst effect and resistance of four specimens of silicon were measured at several different temperatures. The reversal of the Hall effect, which is connected with a reversal of its thermal emf, is not accompanied by a reversal or peculiarity in size of the Nernst effect nor by a peculiarity in the resistance. The temperature coefficients of the Hall and Nernst effect are found to be similar but do not bear any relation to the temperature coefficient of resistance. The extraordinary large Ettinghausen and Leduc effects in silicon reported by Gottstein are not confirmed. The change of resistance of silicon in a magnetic field of 10,000 gausses is less than 0.05 per cent.—*Phys. Review*, December, 1914.

Theory of Transmission.—GEORGE R. DEAN.—The second part of a highly mathematical paper on the differential equations of long-distance transmission.—London *Electrician*, Dec. 18, 1914.

Units, Measurements and Instruments

Nomenclature and Symbols.—A report has been published by the committee of nomenclature and symbols of the (British) Physical Society with a view to a general discussion. As to the terms "magnetic induction" and "magnetic flux density," it is proposed to retain both terms at present. As to "inductance" and "coefficient of self-induction," it is urged to use the term "inductance." As to "permeability" and "inductivity," it is urged to use the term "permeability." As to the terms "electric polarization," "displacement" and "electric flux density," it is recommended not to use "displacement." As to "specific inductive capacity,"

"dielectric constant," "dielectric coefficient" and "permittivity," it is urged to use the term "electric inductivity," and not to use "permittivity." As to "capacity" and "permittance," it is urged not to use "permittance." As to "dielectric strength," "dielectric rigidity" and "electric strength," it is urged not to use "dielectric rigidity." As to "specific resistance" and "resistivity," it is urged to use the term "resistivity." 10^3 is kilo (k), 10^{-3} is milli (m), 10^{-6} is micro (μ), 10^{-9} is millimicro ($m\mu$), 10^{-12} is pico (p or $\mu\mu$). Symbols for units are recommended as follows: Ampere, A, volt V, ohm Ω, coulomb C, joule J, watt W, farad F, henry H, watt-hour Wh, volt-ampere VA, ampere-hour Ah, milliampere mA, kilowatt kW, kilovolt-ampere kVA, kilowatt-hour hWh. A statement of the definition of capacity is added. In a paper by Charles Chres attention is called to notations in common use in terrestrial magnetism and atmospheric electricity.—London *Electrician*, Dec. 25, 1914.

The Relation of the Horse-Power to the Kilowatt.—S. W. STRATTON.—The horse-power is taken by the Bureau of Standards to be 746 watts. So defined, its equivalent in foot-pounds per second varies with latitude and altitude in a determinate manner given in a table. The horse-power defined as 746 watts is very nearly equivalent to 550 ft.-lb. per second at London, where the original experiments were made by James Watt to establish the equivalent of the horse-power. The "continental horse-power," which is used in Germany and France and generally on the continent of Europe, is equal to 736 watts, or 75 kilogram-meters per second at Berlin. It is thus more than 1 per cent different from the horse-power as used in the United States and Great Britain. It is considered desirable that the watt and kilowatt be used as the units of power, whenever possible, for all kinds of scientific, engineering and other work.—*Circular 34 of Bureau of Standards* (Aug. 1, 1914).

The Use of the Hughes Induction Balance for Locating Bullets.—The announcement that the Hughes induction balance is being used to locate bullets in the wounded victims of the war recalls the fact that this instrument was first employed for this purpose when President Garfield was shot by Guiteau. The idea of using the instrument in this way seems to have originated with Prof. Graham Bell, the inventor of the telephone, who, in view of the difficulty found by the doctors in determining where the assassin's bullet had

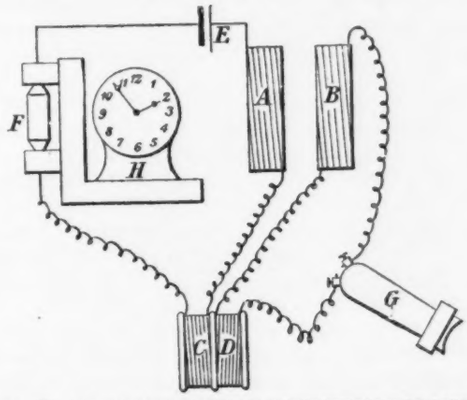


FIG. 2—ARRANGEMENT OF INDUCTION BALANCE

lodged in the President's body, cabled to England, asking Hughes to cable back whether his balance could be used for the purpose of finding the situation of the bullet, and, if so, to add instructions for the assembling of a suitable instrument. This was done, and, with an induction balance, improvised on Hughes' directions, the position was rapidly and accurately determined. The rapidity with which the observations can be made constitutes one of the greatest advantages of the balance for use in military hospitals. The general features of the Hughes induction balance are represented in Fig. 2, in which A and B denote two parallel equal coils of wire similarly wound and so arranged that the distance between them is adjusted at will. These coils are connected by flexible leads, as shown, with another pair of equal coils C and D, oppositely wound, mounted parallel to each other at a fixed distance. Into the circuit of A and C is interpolated a battery and a microphone F, while a telephone G forms part of the circuit which includes B and D. A clock H mounted on the frame of the microphone gives rise by its ticking to a succession of variations in the microphone current, and by induction a current corresponding to each tick of the clock is generated in the telephone circuit. Since, however, the coils D and C are oppositely wound, while A and B are similarly wound, the current induced in D tends to oppose that induced at B, and by adjusting the distance between A and B the one can be caused absolutely to neutralize the other, in which case the ticking of the clock is inaudible in the telephone. If, however, after this balance is secured, the pair of coils CD are brought near a piece of metal, such as a bullet, currents are also induced in this metal, and some of the energy which would otherwise produce current in D is dissipated in the bullet. The consequence is that the balance is upset and a new adjustment of the distance between A and B must be made in order that the telephone may remain silent. The nearer the coils are brought to the bullet, the more exactly their center line intersects the bullet, the louder is the sound in the telephone. Hence, by bringing the coil over the body of a wounded man the direction in which the bullet lies can be ascertained, while by noting what adjustment of A and B is necessary to reduce the telephone to silence the depth below the surface can be found, since it is only necessary to find the distance from CD to which a similar bullet must be brought in order that the telephone shall be again reduced to silence, after the coils CD have been removed from the neighborhood of the patient.—London *Engineering*, Dec. 18, 1914.

Bridge for Measurement of Self-Induction.—D. OWEN.—An abstract of a (British) Physical Society paper in which the author gave a summary of an alternating-current bridge method which is proposed for the determination of self-induction in terms of capacity and resistance. The inductance L is given by the relation $L = K_2 r_1 R$; in addition to which it is also necessary for balance of the bridge to satisfy the condition $K_2 r_1 = K_1 r_2$. The two conditions of balance may be secured in practice without mutual interference. The end point is, therefore, rapidly attained. The possibility of effecting a balance is unlimited by the value of the unknown L. The method is independent of frequency. This has the accompanying advantage that it is unnecessary to employ a pure sine voltage. Very good results may be attained with a buzzer as source and a telephone receiver as detector, at, say, 500 cycles. The dependence of sensibility of the bridge on the frequency is discussed, and it is shown that over a wide range (say, 100 cycles to 1000 cycles) the sensibility is high. The effects of residual inductance in the resistance coils and leads, and of absorption in the condensers, may be simply and correctly allowed for, the formula then becoming $L = K_2 r_1 (R - R_0)$. This fact is of special importance in the accurate determination of very small inductances. Tests are quoted showing that with the same pair of condensers measurements over the full range from one microhenry upward may be made. For inductances of the order of 10 microhenries the error may be kept within a few parts in 1000, while if the in-

ductance is as high as a few millihenries the error of any measurement may be reduced below one part in 10,000. The application of this bridge to the determination of capacity in terms of self-inductance is discussed, and an example is given of a test of the temperature variation of capacity of a standard mica condenser over the range 0 deg.-30 deg. C.—London *Electrician*, Dec. 11, 1914.

Measuring Low Resistances.—F. Wenner and E. Weibel.—The authors discuss the desirability of making certain adjustments in addition to those necessary for establishing the principal balance of the Thomson bridge, in case the resistances under comparison are extremely low.—*Scientific Papers, Bureau of Standards*, No. 225 (May 25, 1914).

Telegraphy, Telephony and Signals

Telephone System.—G. H. Green.—An illustrated description of the automatic and semi-automatic telephone systems of the Western Electric Company, notable features of the system being the construction of selectors used, the method of controlling them by so-called "sequence switches," and the use of selectors serving a larger number of lines than usual.—London *Electrician*, Dec. 25, 1914.

The Radio Operator Problem.—V. Ford Greaves.—The most important characteristics of the good radio operator are proficiency in the use of the code, skill in the care and adjustment of the apparatus, and reliability in an emergency. The requirements of the commercial companies of the navy in these directions are considered. The American Morse code is compared critically with the Continental, and is adjudged superior. The use of the "omnigraph" for test sending is favorably discussed. The requirements for an operator's license of any grade are given, and the problem of appropriate and searching examinations therefor is discussed. The age distribution of radio operators is given graphically and numerically. The salaries and conditions of promotion of operators in the United States Navy, the American Marconi Company and the United Fruit Company are compared.—*Proceedings*, Institute of Radio Engineers, September, 1914.

Possibility of Sharp Directive Wireless Telegraphy.—E. Bellini.—The author first discusses briefly the methods of Brown, Blondel, Stone, Braun, Bellini and Tosi and gives diagrams for these systems and then finds whether it is possible to imagine directive aerials giving sharper diagrams, approaching those obtained with parabolic mirrors and luminous waves. By coupling two aerials a sharper diagram is obtained. The author shows mathematically that by coupling more and more aerials the sharpness can be still further increased.—London *Electrician*, Dec. 18, 1914.

Miscellaneous

The German Electric Industry and the War.—The first part of an article giving details of the arrangements made by the German electrical manufacturing companies for the families of their employees who have gone to the war. For instance, the Bergman Electricity Company has given an extra month's pay to its employees who received monthly salaries and were called to the front. Moreover, at the end of each month the wife of the employee has so far received 50 per cent of the monthly salary, and each child below sixteen years 5 per cent. Those employees who received weekly salaries, as well as the workingmen, have received their salaries up to the date when they were called to the front, and their wives have received so far $1.50 a week and each child below fourteen years 25 cents a week in semi-monthly payments.—*Elek. Zeit.*, Nov. 26, 1914.

Chairman's Address.—P. P. Wheelwright.—The chairman's address to the Manchester Section of the (British) Institution of Electrical Engineers. He thinks that the inducements offered in Great Britain at present to young men to join the electrical engineering profession are insufficient. With respect to the war, the British industry is passing through an extremely critical period, and the future will depend upon the present attitude of the individual, particularly with regard to any imported material. It is hoped that one of the results of this war will be the diversion of German trade into other channels, and it is for Englishmen to secure, with other countries, the trade that has hitherto been carried on with Germany. The British manufacturing works must be kept open. "The wave of practical patriotism which is rolling over this vast empire requires only directing to the sphere of trade to have far-reaching effects. The creation of a nucleus of a demand at reasonable prices, in this country and its dominions, by governments, municipalities and large purchasers setting the example of buying in the home and colonial markets, would provide electrical manufacturers with a sound foundation upon which to build and extend the industry. The moral influence of such an example set by these large purchases would be very great and an encouragement to other industrial concerns to do the same." The author finally refers to headway made in electric-railway operation, the use of labor-saving appliances, and the problem of smoke abatement.—London *Electrician*, Nov. 20, 1914.

Book Reviews

Konstruktion, Bau und Betrieb von Funkeninduktoren. Part 2, Roentgenstrahlentechnik. By Ernst Ruhmer. Berlin: *Der Mechaniker*. 444 pages, 223 illus. Price, 6.5 marks.

The second part of a treatise on the design, construction and operation of spark coils, abundantly illustrated. This part relates to X-ray tubes and their operation. In addition to the introductory material the book comprises eleven chapters dealing with the following topics: Roentgen radiation, apparatus for suppressing the closing current impulse, X-ray measurements, connections between coil and tubes, diaphragm apparatus, X-ray pictures, X-ray kinematographs, X-ray apparatus on alternating-current circuits, X-ray regulation applications. The treatment is clear and fully illustrated. The book will recommend itself to all who are interested in the technics of X-ray apparatus.

Principles of Electrical Measurements. By A. W. Smith. New York: McGraw-Hill Book Company, Inc. 246 pages, 99 illus. Price, $2.

This book deals with units and measurements from the point of view of the physicist. In other words, it treats of principles underlying electrical measurements and pays little attention to matters of construction and design. Its contents, however, should be understood by every electrical engineer, and it is a valuable contribution to the literature of electrical engineering. The book has been written mainly for the instruction of students beginning their course in electrical engineering. The formulas used are developed logically from first principles, thus training the reader to use his reason rather than his memory. The ground covered includes ammeter and voltmeter measurements, condenser methods, using the ballistic galvanometer, measurement of resistance, power and capacity. The magnetic circuit is briefly described, after which follow methods of testing iron and steel, measurement of inductance, and a final chapter on alternating currents.

POWER AND OPERATING SECTION

Auxiliary Equipment for Charging One to Twenty Cells

To provide for special charging of from one to twenty cells of its storage-battery reserve the Edison Electric Illuminating Company of Brooklyn employs an auxiliary switchboard in a room adjacent to the storage battery. The board is connected with bare busbars supported above each row of storage batteries. To these busbars can be attached any cell which needs special charging.

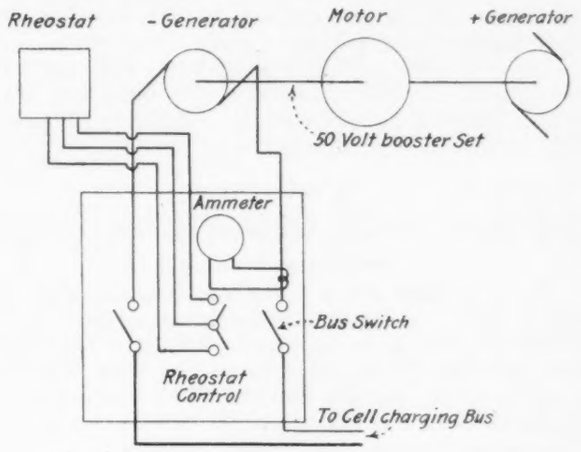


FIG. 1—CONNECTION OF SPECIAL CELL-CHARGING APPARATUS

To avoid using a special charging generator, the company has connected the switchboard with a 50-volt direct-current booster which is ordinarily used during heavy loads to maintain the proper voltage at the delivery end of the feeders. The machine is therefore available a number of hours each day for charging batteries. On the battery-charging switchboard are positive and negative switches, an ammeter and a remote-control master switch. The remote-control switch operates a ratchet rheostat, which varies the voltage of the booster from zero to 50 volts, thereby keeping the current at the proper value. Discharge tests are made periodically on the batteries, to which are also given weekly refreshing charges.

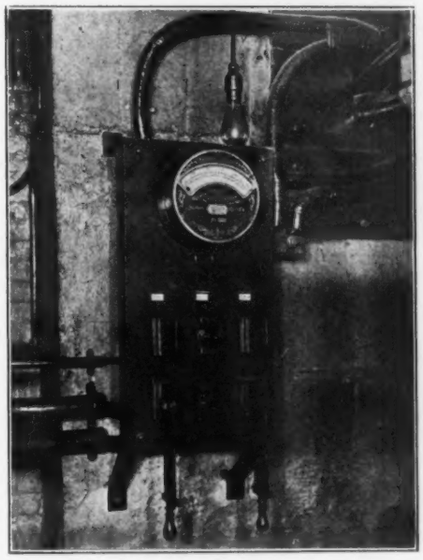


FIG. 2—SWITCHBOARD DESIGNED FOR SPECIAL CELL CHARGING

Babbitt Metal

BY S. U. TUSPIN

Originally babbitt metal had one fixed composition, being made up of 90 per cent of tin and 10 per cent of antimony and copper; but at the present time the term babbitt metal signifies no definite composition, for there are almost as many different kinds of babbitt as there are companies engaged in selling bearing metals. Instead of being used to denote an alloy of tin, antimony and copper, the name now covers practically the whole field of white metals, that is, those composed of tin, lead, copper, zinc and antimony in various combinations.

The reason for this diversity in the components as well as in their percentages is the endeavor to obtain a bearing metal possessing the desired properties at a lower cost than the original babbitt. As a consequence, the cheapest of the babbitts are found to contain a great proportion of lead. The mere fact that a bearing metal is cheap, however, is not to be taken as evidence that its quality is also low. The test of the value of a bearing metal is the way in which it stands up to its work, and so it will be discovered that nearly every one of the different kinds of babbitt has its champion, because some one has found it satisfactory in service.

There has been a great deal of trouble in connection with the selection and use of babbitt metal, caused by lavish statements regarding the value of advertised metals or by the inability of the users to choose kinds suited to their needs. It would scarcely seem necessary to state that a bearing metal of one fixed composition cannot be equally good for all forms of service; yet the mistakes made in selecting grades for different classes of work would seem to indicate that no thought had been expended on the nature of babbitt or on the properties produced by varying the proportions of the constituents.

A satisfactory babbitt metal for a given purpose must be hard enough to retain its form under the load or pressure that may be put on it. It should possess good anti-friction qualities; that is, the coefficient of friction between the babbitt and the journal should be low. Of course, the quality of the lubricant used on the bearing will determine the amount of friction, but there is abundant evidence that the composition of the babbitt also has an influence on the friction. The melting point of the babbitt metal should be lower than that of the shaft or journal, and even if the babbitt should melt, through overheating by friction, it ought not to adhere to the shaft. In order that the lubricant may be enabled to do its best work, the surface of the babbitt should be easily wetted by the lubricant and should hold the film of lubricant well. If the surface repels oil or is not easily covered with a coat of lubricant, heating is apt to occur.

The chemical composition alone is not a safe guide as to the quality of a babbitt, for the reason that the manner of making and pouring the metal will affect its properties. Babbitt is particularly sensitive to overheating, and care must be taken not to heat the constituents or the finished product to such a temperature as to cause volatilization or burning. The safe temperature will depend somewhat on the relative amounts

of the different constituents, but a temperature of from 840 deg. to 880 deg. Fahr. may be safely used in pouring babbitt metal. In the process of alloying the various constituents when making babbitt metal, temperatures of less than 925 deg. Fahr. have been found sufficient. During any melting process the surface of the metal should be kept covered with a layer of powdered charcoal so that oxidation may be prevented.

There are two main classes of babbitt, known as lead-base babbitt and tin-base babbitt, so called because of the predominating elements in them. Of the two, the lead-base metal is the cheaper, because of the fact that lead costs from one-quarter to one-fifth as much per pound as tin. Lead-base babbitt is softer than tin-base babbitt, as a general rule. There is also a difference in color, the lead-base metal showing a bluish tinge, as compared with the yellowish tinge of the tin-base metal.

So far as friction is concerned, lead has the advantage over tin as a bearing metal; but a lead-lined bearing is not practicable, except in unusual cases, because lead works loose in the grooves of the box, and also because it is so soft that it may be squeezed out under pressure. To remedy these faults, lead is alloyed with other metals, such as tin, antimony and copper.

In any alloy the properties of the combined metals are present in the product, but not in the same degree as in the original metals. Therefore, as tin is tough and melts at a low temperature, its effect on a babbitt is to give a tough metal and to lower the melting point. Tin does not possess as excellent anti-friction qualities as lead, and therefore tends to increase the coefficient of friction when alloyed with lead.

The effect of antimony is to reduce the coefficient of friction and to harden the alloy; but, as it is a brittle metal, its addition introduces a certain brittleness into the alloy. It possesses the valuable property of having no shrinkage when poured and allowed to cool, and it induces a similar property in the babbitt, so that the metal, when poured into the box or bearing stays tight in the slots or grooves.

Type metal is an alloy of lead and antimony, there being about eighty parts of lead to twenty of antimony. These proportions produce a metal that has excellent anti-friction properties and that may be used with good results for bearings in which the pressure is not great and in which the speed of the journal is not high. The large percentage of lead in the composition makes this a cheap metal and therefore in great demand. As a result, the refuse metal of type foundries has been worked up into blocks and bars and sold under various names as babbitt.

Copper in babbitt increases the friction; but, as it is a tough metal, it is added in order to toughen the alloy. Only small percentages of copper are used in babbitt metals, although the various brasses and bronzes used as bearing metals contain large proportions of copper.

Zinc is useful as a constituent of babbitt because it wears so well. But its anti-friction properties are low and it shrinks greatly while cooling after being poured. It must therefore be alloyed with some other metal, as tin, to counteract the shrinkage. Babbitt containing zinc and tin will wear well under heavy loads at moderate rotative speeds, but it should not be used for high-speed work.

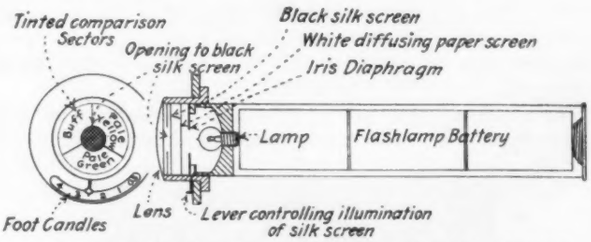
A good babbitt must be homogeneous; that is, it must be of uniform structure and composition throughout. To attain this end it is necessary to use great care in alloying the various metals composing the babbitt. It is also necessary to use high-grade raw materials.

But even a good grade of babbitt may be utterly spoiled in pouring, either by being overheated or by being poured at too low a temperature. If the pouring temperature is too high, the metal will be softened, and if the pouring temperature is too low, the metal will have a coarse crystalline structure. Of the two general classes of babbitt, the lead-base metal is more likely to be injured by carelessness during pouring than the tin-base metal. Blow-holes and shrinkage of the babbitt away from the shell of the bearing may be reduced by heating the shell to a temperature of from 200 deg. to 300 deg. Fahr.

Other things than an unsuitable babbitt metal may cause bearing troubles, however. Failure of lubrication or an unsuitable lubricant for the pressure and speed conditions will cause trouble. Poor alignment of shafts or binding due to badly fitted bearings will cause heating, as will a dirty or gritty lubricant. Abnormal pressure on the bearing, caused by unnecessarily great belt tension, will have a similar effect.

Rapid Illuminometer Exhibited Before Chicago Section, I. E. S.

A rapid illuminometer for rough measurements of light intensity, in which a screen of black silk, illuminated from the rear, is compared with tinted sectors on which falls the illumination to be measured, was exhibited by Prof. Morgan Brooks, of the University of Illinois, before a meeting of the Chicago Section of the Illuminating Engineering Society recently. In the model constructed by Professor Brooks from a hand flash-lamp and a camera shutter mechanism, as sketched herewith, the degree of illumination from the battery



HAND ILLUMINOMETER USING BLACK-SILK SCREEN

lamp reaching the translucent black silk screen through the intervening diffusing paper is controlled by the manipulation of the iris diaphragm. The lever is moved until the apparent brightness of the silk screen by transmitted light approximates the illumination on the annular comparison cards surrounding the silk-screen target. The illuminometer is originally calibrated by marking positions of the iris lever corresponding to various known intensities along a photometer beam.

By the provision of the tinted comparison screens it is possible to secure close matching of the silk-screen illumination with the reddish rays of a carbon lamp as well as with the whiter light of a tungsten unit. When measuring carbon-lamp illumination the silk target is compared with the pale-green sector, and when judging tungsten lighting, with the yellow or buff-colored sectors. Professor Brooks also exhibited a large-size demonstration illuminometer model in which the lamp source was controlled by a rheostat. With his hand illuminometer the speaker estimated that ordinary room illumination could be measured with an accuracy of 10 per cent.

In the discussion Mr. J. R. Cravath expressed doubt whether the accuracy of practical field work with even a Sharp-Millar portable photometer averages within 10 per cent of error, or reaches values within 5 per cent of error. Chairman W. A. Durgin mentioned the early Marsh illuminometer, based on a somewhat similar principle but without the tinted comparison sectors,

which he thought especially valuable. He suggested the use of storage cells to operate the illuminometer lamp, since tests of flashlamp batteries have shown that there is a comparatively rapid fall of voltage during the first fifteen minutes of operation, after which the pressure remains fairly constant for a one-hour run. Such a battery after a one-hour run and one-hour rest recuperates to nearly the same voltage and will then repeat its former discharge curve at a depressed potential. Dr. M. G. Lloyd pointed out the fact that since the silk threads making up the transmitting screen cannot absorb all of the incident exterior light, the silk screen will be illuminated to a slight extent from the outside. This constant error is compensated for, however, by the method of direct calibration by comparison. Mr. Albert Scheible spoke of the need for a portable illuminometer for rough work. Such a device should be easily manipulated.

In closing the discussion, Professor Brooks mentioned that to obtain constant results with the new illuminometer the target should be viewed directly from the front. The presence of the lens helps to insure this condition. A small mirror or prism might be added to avoid shadow on the comparison screen caused by the head of the observer. Fine lines photographed on glass and halftone screens used by photo-engravers have been suggested as improvements on the black silk.

Electric Pump for Removing Water from Sewer Trenches

The Utah Light & Traction Company, Salt Lake City, recently entered into a contract with the Ulen Contracting Company to supply energy for pumping water out of sewer trenches which the contractor is digging for a large sewer-pipe system, covering about 70 miles of pipe, ranging in size from 6 in. in diameter to 60 in. in diameter. The electric company has prepared a map showing the location of the sewer line to be installed and the location of its primary circuit, both three-phase and single-phase, in the same territory. It has been found that the three-phase lines are not farther than two blocks from every trench which the contracting company will build, and that there are single-phase lines not farther than one block from every trench.

The district to be covered by the sewer-pipe system is heavily watered, and in some places the ground water

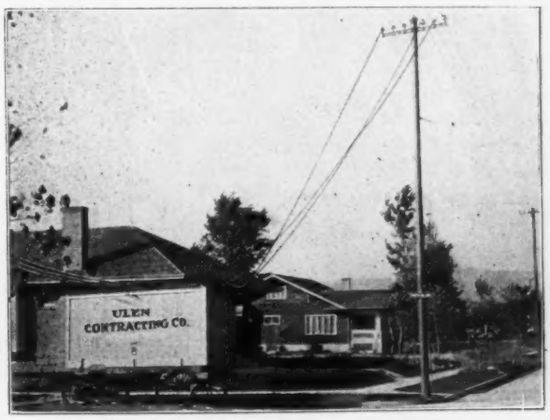


FIG. 1—PORTABLE SUBSTATION

comes within 2 ft. of the surface. In places where the inflow of water is heaviest, the pumping outfits will be operated in batteries of from six to ten units, each unit consisting of one 4-in. centrifugal pump directly connected to a 5-hp, three-phase or single-phase motor. The portable substation shown in Fig. 1 is employed to transform the high-voltage energy to low-voltage energy for the motors operating the pumps. Portable cables,

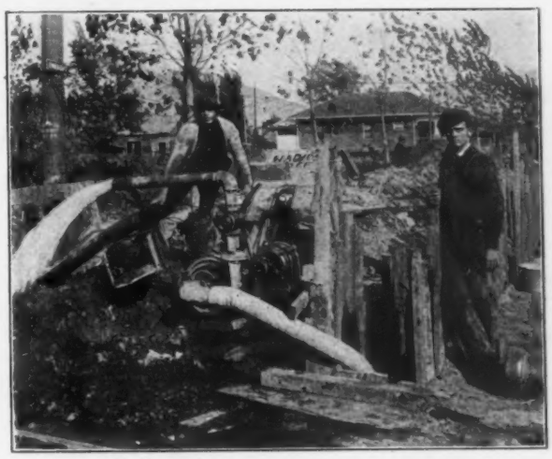


FIG. 2—PUMPING WATER OUT OF TRENCH

2000 ft. long, are used to transmit the energy from the substations to the pumps. In Fig. 2 is shown one of these pumps in operation.

Induction Motor Drive for Glass-Blowing Machines

One of the largest customers of the Muncie (Ind.) Electric Light Company is the Ball Brothers Glass Manufacturing Company. More than 1800 hp in motors is connected to the central-station company's lines at this factory, and still other motors are operated from the glass company's own oil-engine direct-current plant. Changes have been continually going on in the factory, adding more motors to the electric company's lines and decreasing the number of direct-current motors. The most recent of these transfers occurred when adjustable-speed induction motors were applied to Owens automatic glass-blowing machines making fruit jars.

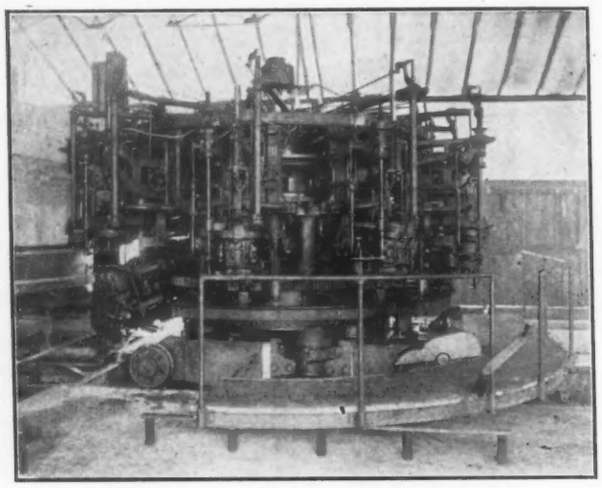
At first the Owens company was opposed to the use of adjustable-speed induction motors, because of the lack of close speed regulation. A thorough investigation of the service required, however, developed the fact that a speed variation of two to one would be satisfactory. At maximum speed the Owens machine turns out thirty-six fruit jars a minute, while the minimum is eighteen jars a minute. The exact speed necessary to get the greatest production depends on the outside temperature, and as these machines must run at this maximum the steps in speed control could not make a difference of more than one jar a minute.

Tests showed that a motor was needed with an output at full speed of 2.6 hp and an output at half speed of 2.3 hp. The controller required eighteen steps between full and one-half speed and an automatic push-button attachment, so that the machine could be stopped or started from several points.

A standard 5-hp, 1200/600-r.p.m. motor with a special controller and contactor panel was recommended for this service. Each glass machine also required a 7.5-hp, 900-r.p.m. motor with heavy starting characteristics. A standard constant-speed slip-ring type motor was suggested for this work. Besides this a 3-hp adjustable-speed motor was used for turning the glass pot of each outfit.

When the motors were installed it was found that the 5-hp motors were too light, owing to the fact that

14.5 hp was needed at starting. These motors were replaced with 7.5-hp machines of the same type, and after some changes were made in the special controllers the outfit proved a complete success. The speed con-



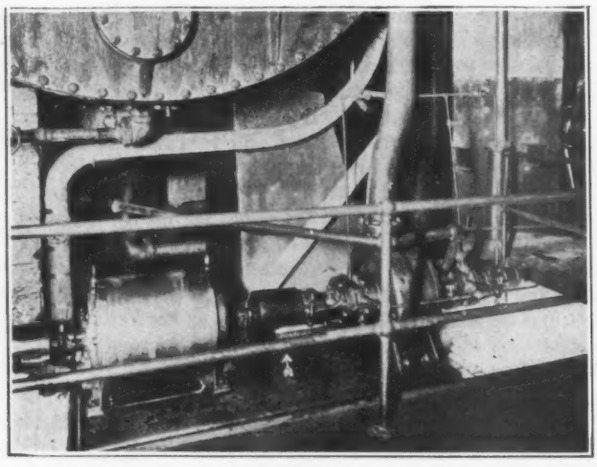
AUTOMATIC GLASS-BLOWING MACHINE

trol is as close as it was with the direct-current motors, and 75 per cent of the motor trouble has been eliminated.

Eleven sets of three motors each have now been purchased. Two sets are for the glass company's plant at Wichita Falls, Texas, while the remaining nine sets are being used at Muncie, adding 162 hp of twenty-four-hour load to the lines of the electric-service company.

Guards for Pump Pits and Equipment Therein

Since pumping apparatus is usually installed in darker places than any other equipment used in generating stations, it is highly important that guards be provided around the machinery to prevent employees becoming injured thereby. In the stations of the Edison Electric Illuminating Company of Brooklyn much care has been taken to prevent accidents. Where centrifugal pumps driven by turbines or motors are employed the couplings



RAIL AROUND PUMP PIT AND GUARD OVER COUPLING

and governors are covered with shields as shown in the accompanying illustration. Railings have also been provided around the pits containing hot-well pumps to prevent persons falling therein.

Power Data on Cottonseed Oil Mill

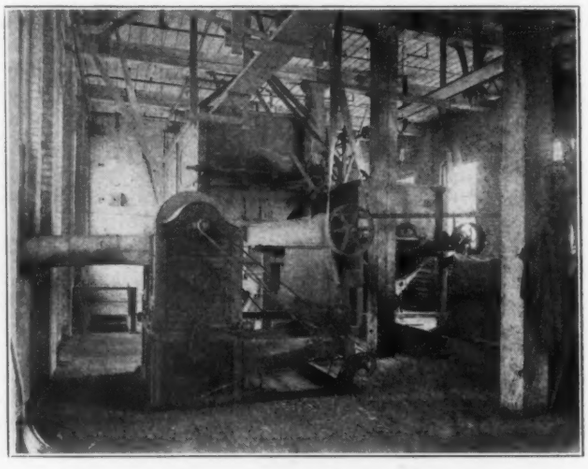
One of the industries which supply a twenty-four-hour load for the Kansas City (Mo.) Electric Light Company is a mill producing cottonseed oil and its by-products, cotton and hulls. The rated capacity of this mill is 100 tons of seed in a twenty-four-hour day, but data compiled show that the average output is actually

MOTOR APPLICATIONS IN COTTONSEED-OIL MILL

No.	Hp	R.p.m.	Application
1	25	710	Belted to 10-ft. shaft (two hangers); motor pulley 16 in. by 10 in.; driven pulley 32 in. by 10 in., driving 160 ft. of 12-in. and 14-in. conveyor.
1	100	750/715	Belted to 90-ft. shaft (eighteen hangers); motor pulley 21 in. by 17 in.; driven pulley approximately 50 in., driving nine linters, three hullers, screen and cleaners, six seed elevators, one saw-filing machine, one shaker, one 2-kw generator for magnets.
1	50	750/715	Belted to 12-ft. shaft (two hangers); motor pulley 12 in. by 14 in.; driven pulley 42 in. by 14 in., driving one roll machine.
1	75	750/715	Belted to 85-ft. shaft (sixteen hangers); motor pulley 16 in. by 14 in.; driven pulley approximately 42 in. by 16 in., driving nine linters, four beaters, two elevators, one sand screen and 150 ft. of 12-in. conveyor.
1	15	750/715	Belted to gearing; motor pulley 8 in. by 8 in.; driven pulley 30 in. by 8 in., driving triplex oil pumps.
1	25	750/715	Belted to 12-ft. shaft; motor pulley 9 in. by 9 in.; driven pulley 20 in. by 14 in., driving cake breaker.
1	25	750	Belted to 12-ft. shaft (two hangers); motor pulley 13 in. by 9 in.; driven pulley 60 in. by 9 in., driving 100 ft. of 12-in. conveyor and one elevator.
1	10	750/715	Belted to 25-ft. shaft (four hangers); motor pulley 7 in. by 6 in., driving 100 ft. of 10-in. conveyor.
2	25	750/715	Belted direct; motor pulley 7 in. by 14 in.; driven pulley 42 in. by 14 in., driving one set of five cookers.
1	75	750/715	Belted to 90 ft. of 10-in. conveyor and one elevator.
*2	35	750/715	Belted direct to grinder; motor pulley 13 in. by 12 in.; driven pulley 17 in. by 12 in.
*2	35	750/715	Belted direct to grinder; motor pulley 13 in. by 12 in.; driven pulley 17 in. by 12 in.

*Only one grinder is in operation at a time.

95 tons. The mill runs on two twelve-hour shifts and gives steady employment to twenty-five men. As shown in the accompanying table, the total connected load at the mill is 522.5 hp, and tests which have been conducted showed the maximum demand to be 288 kw. The load-factor based on the operating period was shown during the same set of tests to be 64.3 per cent, and the power-factor of the installation, as indicated by a three-phase



ELECTRICALLY OPERATED COTTONSEED-OIL MILL

power-factor meter, was 92 per cent. With motor equipment installed as shown in the table herewith, it has been found that an average of 73.2 kw-hr. is needed to handle a ton of cottonseed.

COMMERCIAL SECTION

"So the Public May Understand"

In the offices and about the properties of central stations which continue the once-a-month plan of reading meters and issuing all bills, heavy work falls on the meter readers, accountants, cashiers and others about the first of the month. "So the public may understand" if delay is encountered at this time in the payment of bills or the adjustment of complaints, the manager of one Alabama central station has had the following notice posted at the side of the cashier's cage, where it meets the attention of every visitor to the office: "The first ten days of the month and the last ten days of the month are our busiest periods. In ordering new service connections please give us, where possible, plenty of time."

How the Contractor Can Benefit Himself

Contractors are rapidly developing into the medium through which manufacturers, jobbers and central stations are able to reach the ultimate consumer. A number, however, have not awakened to the fact that they can benefit themselves as well as the electrical business as a whole. The manner in which this can be done was outlined in a paper presented recently before the Oregon Electrical Contractors' Association by Mr. John F. Ryan. In opening his paper the author pointed out that success in contracting as well as in other branches of the electrical industry can be obtained by constructive co-operation.

By co-operation is not meant the banding together of contractors for the purpose of regulating or controlling prices nor the forcing of a weaker competitor to discontinue business. On the other hand, every contractor should co-operate with his business associates by becoming a member of any organization whose object is to uplift or develop his particular line of business. Broad-minded contractors who realize the advantages of exchanging ideas should try to persuade narrow-minded fellow workers to share the benefits from co-operation. Of course, there are a number of so-called contractors who cannot see beyond the sphere of their own little business and who never can be educated to co-operate. This type of contractor is a detriment to the entire electrical industry. He knows nothing about overhead expense or the cost of doing business and accepts contracts at such a low margin of profit that he must employ the cheapest grade of material. As a result legitimate contractors who use better material cannot offer such attractive prices and central-station companies will be criticised for interruption of service if the low-grade equipment burns out. Contractors employing these poor business methods will eventually become so heavily involved that the jobber must carry the burden of their failures. Contractors of this sort should be shunned by all branches of the electrical business, as their work is destructive rather than constructive.

By interchange of experiences contractors may become acquainted with the most economical methods of conducting business. To uplift the standard of the electrical business, contractors' associations should encourage their members to work in harmony with the National Board of Fire Underwriters by using nothing but approved material. Each contractor should take a personal pride in the appearance of his retail store, thereby demonstrating to the central station, jobbers and manufacturers that he is capable of properly handling the distribution of energy-consuming devices. Furthermore, he should endeavor to give his support to the electrical jobber distributing in his territory. If a contractor purchases his material directly from the manufacturers, he will have to invest a considerable amount in stock in addition to providing space for storage. This may increase his overhead expenses to such an extent that it will retard the progress and development of his business. When contractors concentrate their efforts and specialize along their own particular line electric-service companies in this country will undoubtedly discontinue their wiring departments and concentrate their efforts on the generation and distribution of electrical energy.

"Could Not Exist Without Ice Business"

The small central station which has trouble "making ends meet" might take a profitable lesson from the experience of a Texas plant where a 10-ton ice machine was installed to eke out the earnings of the 40-kw electric generator. Of the fifteen-thousand-dollar business now done annually by this company, the ice plant alone returns a gross earning of $10,000, and of this amount $3,000 represents actual profit above the extra cost of labor, fuel, delivery and accounting. The entire property is now paying a return of 17 per cent on the investment, whereas, according to the manager, "we could not have existed without the ice business." The demand for ice during many months of the year in this Texas town makes electric service possible, although it is admitted that without the ice-making adjunct electricity might be out of the question at ordinary rates.

Circulating Motion-Picture Films to Stimulate Electrical Business

Some electric manufacturing and central-station companies have spent large sums of money producing motion-picture films advertising their business, but owing to the obvious purpose thereof they have been unable to secure the circulation that would be obtainable if the films were made primarily for entertainment with the advertising presented less prominently but in such a manner as to develop the electrical business. Not only are these advertising companies compelled to pay motion-picture producers large amounts for displaying the pictures, but in many cases they are refused circulation entirely because the public will not pay admission to see pictures of an advertising character and for which the producing company has already been paid a large advertising fee. To display such pictures at all it is therefore usually necessary to produce them at electrical meetings, conventions, lectures, or in the advertiser's own building. For presenting pictures which are not easily circulated it has been suggested that the owners maintain or rent theaters in the locality where the pictures will have the best effect and issue complimentary admission tickets to residents in different sections of the city for successive performances.

By producing human-interest pictures which stimulate electrical business without laying too much emphasis on it, Mr. L. G. H. Smith, of the Society for Electrical Development, Inc., has succeeded in circulating five reels through some of the leading motion-picture circuits in this country. Not being connected with any particular electrical manufacturing or central-station company, the society has not been required to pay any

advertising fee. Its success in conducting this propaganda has been due to the fact that no particular companies' goods were displayed in the pictures and the scenario was made of popular interest without forcing the electrical features into prominence. Actors of one of the large film-producing firms were employed to pose for the pictures, their expenses, salaries and property being paid for by the Society for Electrical Development.

How the Curbstone Meter Reader Works

Sound argument against providing meter readers with previous readings of customers' meters was presented by Mr. M. J. Flynn, Kansas City, Kan., before the convention of the Kansas Water, Gas, Electric Light & Street Railway Association. He said that unless the meter readers are known and can be absolutely trusted, which is generally the case in smaller cities, trouble is apt to arise on account of the men filling in readings based on customers' previous monthly bills. Also, the meter reader, even though cautioned against the practice, is likely to disclose the size of the other bills in the neighborhood to certain customers, causing discontent if the person informed happens to have paid more for service that month than his neighbor. The practice of giving the customer an estimate of his bill should also be discouraged, for if the meter reader gives a wrong estimate the customer is sure to believe that the company is defrauding him.

Dealers Offered Commission by Central-Station Company in Percolator Campaign

Different household electrical appliances are offered each month at greatly reduced prices by the Edison Electric Illuminating Company of Brooklyn, which is encouraging the dealers to do likewise by giving them commissions on each unit sold. The commission is allowed by furnishing appliances to the dealers at liberal discounts and allowing them to conduct their sales independently but at the campaign price. During November a coffee percolator was featured at $5. The special sale was advertised on electrically illuminated billboards, in newspapers and on folders which were distributed with the electric-service bill. The last method of reaching the consumers directly is considered very satisfactory by the appliance-sales manager, as the expense of delivering the bill and folder attached is no greater than for the bill alone. On one-half of the folder is a description of the percolator with a statement of its advantages and cost of operation. The

$5.00-FIVE DOLLARS-$5.00
BUYS THE NEWEST TYPE ELECTRIC COFFEE PERCOLATOR
EDISON NOVEMBER SPECIAL
THE EDISON SHOP 360 PEARL ST. BROOKLYN

FIG. 1—BILLBOARD ADVERTISING PERCOLATOR CAMPAIGN

other half is a post card addressed to the central-station company which can be filled in by the consumer desiring a percolator at the special price. Only a limited number of appliances are sold each month at the special price, which ceases to be effective after the month is over.

To attract the attention of persons who may pass by or visit the company's buildings the electric shop and branch office show windows were equipped to display the percolator prominently. Other devices are also exhibited to arouse interest in the general use of electrical appliances. The windows are dressed each month by one of the leading window decorators in Brooklyn. While the devices are sold at prices which are very attractive to the public, the appliance-sales department makes a desirable profit on each unit sold. The gross profits are reported to average about $1,000 a month, so that the appliance department is self-supporting. Deliveries are made with an electric vehicle capable of traveling about 75 miles on one charge.

FIG. 2—DISPLAY WINDOW IN BRANCH OFFICE

Contractors and Central Station Co-operate in Monthly Campaigns

Each month the Philadelphia (Pa.) Electric Company features some electrical appliance in a campaign participated in by local contractors. In one campaign recently conducted washing machines were offered at about 82.5 per cent of the regular list price. All advertising material was furnished by the electric-service company. Contractors were required to act only as agents, so it was unnecessary for them to go to any expense in maintaining stock, preparing advertisements and making deliveries.

Return post cards attached to green folders describing the washer and the terms of the special sale were sent to each residence consumer with his monthly bill for electric service. By signing and mailing the card to the company consumers were enabled to reserve machines at the special price, provided they purchased them within the month. Newspaper advertisements were run for a period of ten days, using a different paper each day. In the smaller newspapers double-column announcements were published. A small amount of space was also employed in weekly editions to reach certain localities. In each of these advertisements were published the names and location of branch offices and contractors taking part in the campaign.

To each agent having display space were sent a sample washer for demonstration and also suitable decorations for show windows. Display cards presenting briefly the facts of the campaign were also distributed. One feature of the campaign which made it especially successful was the six months' deferred payment allowed. Consumers were allowed to pay $10 on receiv-

ing the machine and to give $5 when paying electric-service bills each month until the washer was paid for. While washers were not offered on trial, this was done in a number of cases with good results.

Outside demonstrators employed by the electric-service company followed up all leads received through return post cards and other sources. They were allowed

YOU CAN SAVE
$15.00
on the price of this Washing Machine
DURING September only, we offer our customers a standard, guaranteed Western Electric Washer and Wringer—regular price $85.00—at the very low price of $70.00, an actual net saving to you of $15.00.
Washing the Electric way is a boon to the housewife—it is the easiest, quickest, the most thorough, sanitary and economical way, and this is true whether you do your own washing, have a servant to do it, or send it to a laundry. Convince yourself—a demonstration in our Electric Shop or District Offices places you under no obligation whatever.
Orders for the Electric Washing Machine and Wringer may be sent direct to the Philadelphia Electric Shop at Tenth and Chestnut Sts., or turned in at any of the following locations:
L. C. Blandin, 16 S. 16th St.
J. F. Buchanan & Co., 1719 Chestnut St
Cates & Shepard, 1516 Sansom St.
Central Electric & Lock Co., 11 N. 13th St
Herman Eckstein, 1741 Sansom St.
Albert Gerstel, Inc., 1501 Columbia Ave and 4466 Germantown Ave.
William Hoyle, 412 N. 60th St.
Industrial Mfg. & Electric Co., 416 N Orianna St.
Walter Jahn, 224 S. 40th St.
Edmond A. Lee Co., 1716 Sansom St.
Lewis & Lamont, 3071 Kensington Ave.
Nicholson Electric Co., 1012 Walnut St.
Progress Electrical Construction Co., 32 N. 7th St.
Elias Nusbaum & Bros., 1526 Sansom St.
The Quaker Light Supply Co., 728 Arch St.
Sies & Faber Co., 3008 N. Front St.
Edward A. Wiegand & Co., 5855 Germantown Ave.
Wright & Wright, 1930 W. Susquehanna Ave.
The Philadelphia Electric Co.
9 S. 40th St.
The Philadelphia Electric Co.—Continued
18th St. and Columbia Ave.
213 W. Susquehanna Ave.
Gray's Ferry Road and Carpenter St.
7 West Chelten Ave.
4522 Frankford Ave.
Lehigh Ave. and Potter St.
6162 Main St., Manayunk
Oak Lane
The Beacon Light Co., 515 Market St., Chester, Pa.
Delaware County Electric Co., Lansdowne, Pa.
We will give you the benefit of exceedingly liberal terms—$10.00 at time of purchase and $5.00 each month with your bill for Electricity until the machine is paid for. On and after October 1st, the regular price of $85.00 cash or $90.00 on the six months' deferred-payment basis will apply
The PHILADELPHIA ELECTRIC COMPANY

NEWSPAPER ADVERTISEMENT WHICH INCLUDES CONTRACTORS' NAMES

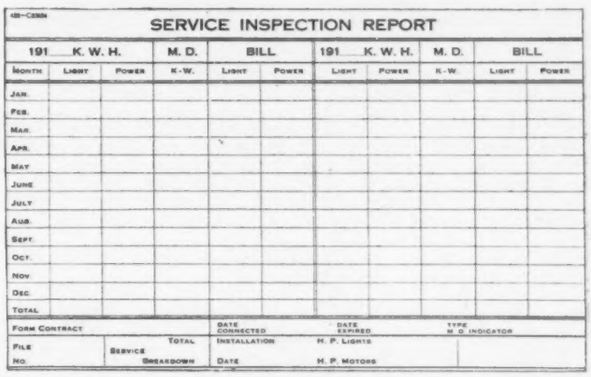
a liberal commission on each sale, as were also the contractors. During the campaign 103 washers were sold, probably 75 per cent of which were placed in homes on the part-payment plan. Toaster stoves and percolators were sold at other times on a similar basis, about 500 of the former and 250 of the latter being disposed of, it is reported.

Keeping Industrial-Motor Users Satisfied

To secure a contract for supplying energy to large motor users usually involves considerable time and expense, therefore every effort should be made to retain their business by keeping them satisfied with their electrical equipment as well as with the electric service. The importance of keeping a consumer satisfied should not be underestimated. Sometimes the customer's grievance is of a kind which, after being investigated, can be easily alleviated. At other times complaints may be justly founded and require considerable effort to clear up. In general, attending to small grievances leaves as lasting impressions on the consumer as performing greater services. A satisfied consumer is one of the best business builders of the central station, as he will employ more electrical equipment as occasion demands and will often recommend the utilization of electrical energy to others.

The facts mentioned above are realized by the Edison Electric Illuminating Company of Brooklyn, N. Y., which makes it a point to keep in close touch with all consumers using more than 50 hp in motors or whose revenue is $2,400 a year or more. This is done by having representatives of the service inspection bureau call on the consumers periodically to inquire as to the satisfactoriness of the service and to suggest, if possible, how the contracts can be adjusted to be more advantageous to the consumer. In this way the central-station company acquires the confidence of each consumer and also prevents his receiving advice from unscrupulous engineers who may suggest changes whereby they will profit personally. The chief object of this consulting service is to develop additional business, therefore it is especially important where only partial service is being supplied. In such cases it may be only necessary to explain advantages of modern electrical equipment to effect the gradual electrification of the complete plant.

To facilitate conducting the service inspection bureau, a card-record system is employed. Copies of both sides of one of the cards are shown herewith. One side is for data relating to the customer's installation, energy consumed, amount of bills, maximum demand, form of contract, date of service connections, and expiration of contract. The reverse side of the card is devoted to the notation of results of inspection calls and advertising material sent out. Every electric-service bill of a consumer under the supervision of the service-inspection bureau is checked by representatives thereof, and the amount of the bill noted on the corresponding

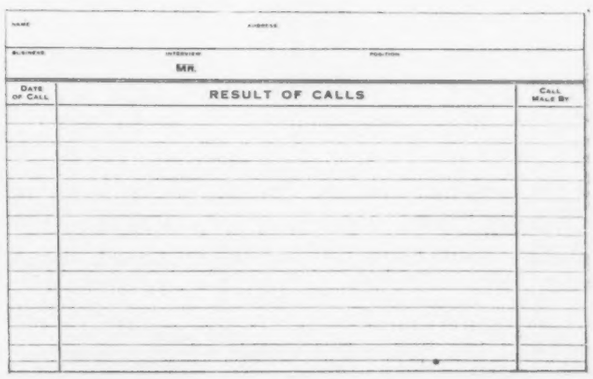

SERVICE INSPECTION REPORT

191	K. W. H.		M. D.	BILL		191	K. W. H.		M. D.	BILL	
Month	Light	Power	K-W.	Light	Power		Light	Power	K-W.	Light	Power
Jan.											
Feb.											
Mar.											
Apr.											
May											
June											
July											
Aug.											
Sept.											
Oct.											
Nov.											
Dec.											
Total											

Form Contract — Date Connected — Date Expired — Type M. D. Indicator
File No. — Service: Total / Breakdown — Installation — H. P. Lights — Date — H. P. Motors

FIG. 1—ONE SIDE OF CARD USED BY SERVICE INSPECTION BUREAU

report card in the spaces provided for that purpose. After comparing the card and bill to see if any appreciable increase or decrease in energy consumption has


Name — Address
Business — Interview — Position
MR.

Date of Call	Result of Calls	Call Made By

FIG. 2—REVERSE SIDE OF CARD USED BY SERVICE INSPECTION BUREAU

been made, the manager of the bureau sends the bill to the fiscal department, where it is mailed to the customer. By this procedure occasions for complaints regarding incorrect billing are prevented. The card also indicates whether the consumer is obtaining the maximum amount of possible service from the equipment installed.

In selecting men to interview the owners of large

industrial installations the company gives consideration to the following qualities: The representative must have a personality and address which will enable him to meet on equal terms the largest customers of the company; he must have sufficient initiative and tact to handle these customers without stirring up complaints, and he should be able to anticipate grievances and have them settled before they become realities. Furthermore, it is essential that the men be versed in engineering as well as salesmanship and be always alert to the possibility of securing new business. In addition, the representative must be of sufficient caliber to comprehend the full intent and purpose of the company in making these interviews, and must realize his responsibility in obtaining satisfactory results.

When the inspection service was first established many of the consumers were curious to know why the company inquired into the satisfactoriness of its service. This opportunity was therefore taken to point out to the consumer that the company desired to offer a service which would assure them of the customer's business in future years. Some of the complaints which were settled to the satisfaction of the consumers follow: In one case, where the consumer's bill was based on the maximum demand, the motors were re-grouped to give an increased output for the same expense. At another place, where a private generating plant had been shut down and the customer was heating his own building, suggestions were made which reduced the fuel cost approximately 50 per cent. Another customer who was paying for energy for motors and lamps on separate contracts was advised to sign a new contract for the combined service to reduce his monthly bill.

Special Privileges for the Popcorn Man

A vender of popcorn and crackerjack in Leavenworth, Kan., has the local central-station company's permission to take electrical energy for lighting his wagon from any outlet he can reach along the city's "white way." Having secured this liberal arrangement, the popcorn man is not obliged to conduct his business in any one place, but can move about along the six blocks of "white way," keeping his wagon always where trade is best.

Economics of the Rural-Customer Problem

Lines of the Noblesville (Ind.) Heat, Light & Power Company constructed along country roads to supply the farmers of Hamilton County with electric service are built of 25-ft. poles spaced 200 ft. apart. Following the company's standard practice, using No. 8 bare hard-drawn copper wire and 30-in. telephone cross-arms, the average cost of a mile of line is as shown in Table I.

TABLE I—COST OF A MILE OF RURAL-SERVICE LINE.

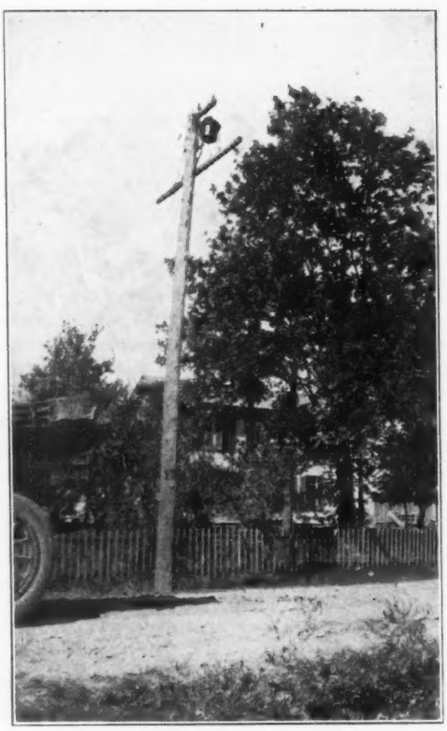
	Unit Price	Item Cost
Twenty-seven poles (25 ft. high with 5-in. top)	$1.15	$31.05
10,560 ft. No. 8 copper wire	0.16	126.40
Twenty-seven telephone cross-arms	0.13	3.51
Twenty-seven through bolts	0.05	1.35
Fifty-four locust pins	0.013	0.70
Fifty-four insulators (porcelain)	0.03	1.62
Fifty-four square galvanized washers	0.009	0.50
Guy anchors (average)	.....	5.00
Labor and hauling	.....	72.00
Total field expense for material and labor	.....	$242.23

This table of expense includes nothing for supervision, use of tools, insurance or interest, and it is estimated that the actual cost, including everything, is about $300 a mile. The company therefore starts with an initial investment of $100 a mile, since the farmer customers deposit $200 a mile, and the company's investment is later increased to $300 a mile when it acquires the line according to the plan outlined in the ELECTRICAL WORLD of Oct. 11, 1913.

TABLE II—FINANCIAL DATA ON RURAL-SERVICE LINE.

Average Monthly Bill per Customer	Annual Gross Revenue per Mile	Annual Net Revenue per Mile	Annual Interest	Annual Surplus
$1.00	$48.00	$19.20	$36	−$16.80
1.50	72.00	28.80	36	− 7.20
2.00	96.00	38.40	36	+ 2.40
2.50	120.00	48.00	36	+ 12.00
3.00	144.00	57.00	36	21.60
4.00	192.00	76.00	36	40.80
5.00	240.00	96.00	36	60.00

Assuming that 60 per cent of the gross revenue from this line is used in operating expenses, then 40 per cent is left for interest, depreciation and profit. If interest is assumed at 7 per cent and depreciation at 5 per cent, then 12 per cent of $300, or $36, will need to be charged against each mile of line. Table II, worked out on this basis, shows how much revenue must be received from each customer before his account is profitable.



"THE OLD HOMESTEAD"—A TYPICAL RURAL CUSTOMER

From these data it will be seen that until the customer's bill averages nearly $3 a month rural lines are not a paying experiment under these conditions as the interest and depreciation charge includes nothing for the generating station. After the customer has passed the $3 a month average bill, however, he becomes a profitable patron. During the development period the deficit shown is somewhat offset because of the interest charge being lower as the customer has had only a part of his advance payment refunded.

Concentric Wire for Interior Lighting Circuits

Concentric wire such as is being advocated by many as a means toward reducing the cost of electric wiring and thus overcoming the greatest obstacle met by central stations in soliciting the small consumer has been

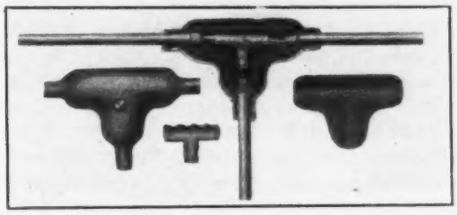


FIG. 1—T-JOINT BOX, SHOWING COMPONENT PARTS

used with success in England and on the European continent for some time.

In England Stannos wires manufactured by Siemens Brothers & Company have come into extensive use for this purpose, having been introduced in that country for the same purpose as concentric wire is advocated in America.

Stannos wire consists of a single or stranded tinned-copper wire insulated with pure and vulcanized India rubber, taped and then lapped round twice by a closely fitted, compressed sheet of tinned copper, the whole being rendered homogeneous by a special process and tested at a pressure of 1000 volts. Two conductors are hence available, the one being the wire core and the other the sheathing. When used as concentric wire both the core and the sheathing are utilized as conductors. In such a case the sheathing, the sectional area of which is slightly greater than that of the inner con-

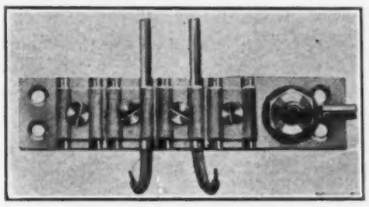


FIG. 2—CONTINUITY BUSBAR FOR FUSE BOARD

ductor, is grounded. In the case of a three-wire system two concentric wires are employed, their sheathings being connected together and grounded.

This wire may be used for either surface or concealed work. When used for surface work it is attached to the walls, ceilings, etc., by means of clips taking one or more wires. Being small in size, the presence of the wire is often not objectionable. When the wire is used for concealed work chases are first cut into the plaster and the wires are laid in them, being held in place, if necessary, by cushion clips. The chases are then filled with plaster and the wire thus concealed.

FIG. 3—TINNED-COPPER EARTHING CLIP

In installing wires care is always taken that an efficient grounding connection shall be made at every distribution board or fuse box with the nearest water main. Some idea of the fittings employed can be attained from the accompanying illustrations. Fig. 1 shows a T-joint box. The sheathings, it will be noticed, are electrically connected, and the shell of the box and the inner conductors are fastened together by means of solder and a special clip.

Fig. 2 shows a typical continuity busbar. The sheathings are all clamped as shown to the metallic busbar, and the inner conductors of the concentric wire are allowed to project for connection to another busbar or terminal.

In Fig. 3 is shown a tinned-copper earthing clip suitable for bolting to a continuity busbar or for earthing the sheathing before looping in and out of a meter, or when connected to any piece of apparatus with two terminals. The concentric wire is inserted in the sectionalized cylindrical portion of the clamp and is firmly held in place when a bolt is passed through the clamping tongues.

Fig. 4 shows a typical house-service box for this type of wire. By using a box, a row of contiguous houses can be served from one feeder. The box is of galvan-

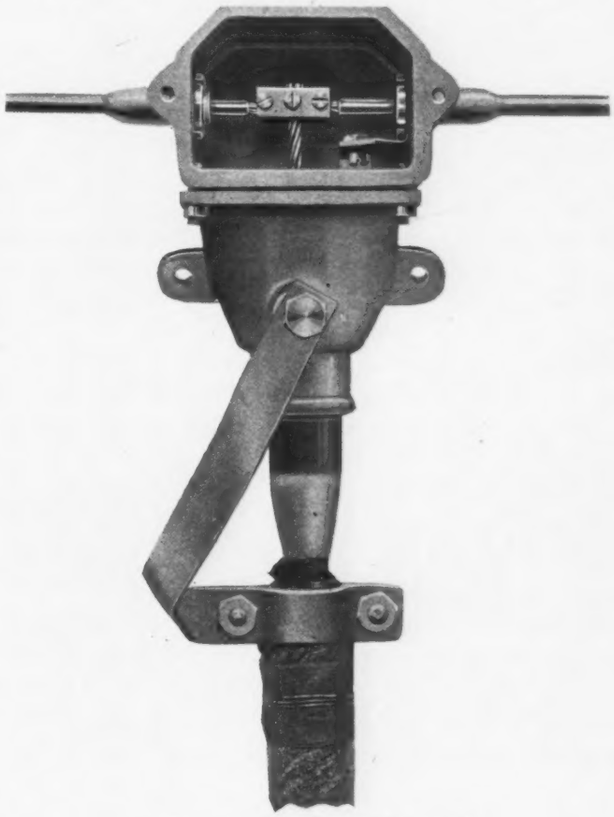


FIG. 4—HOUSE-SERVICE BOX

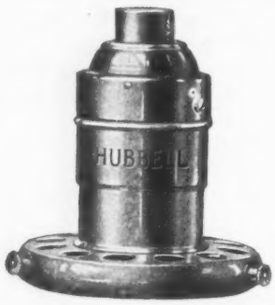
ized cast-iron and is suitable for bolting vertically to a wall in an exposed location, if necessary. The low-tension concentric service cable enters the sealing chamber forming a part of all fittings at the bottom. The lead sheathing of the cable is wiped to the box and the armoring is bonded to the box by means of a wrought-iron clamp as shown. The outer conductor of the concentric cable is bunched and sweated into a fitting which is bonded to the upper part of the box.

Stannos wire is supplied in coils having a diameter of about 21 in. When being unwound from the coils the wire is fastened immediately to its supports by means of saddles or clips. The wire can be bent by hand or by means of bending tools. Bends and elbows are hence unnecessary, and no large stock of fittings need be maintained by the electrical contractor. Erection of the wires is easily and cheaply done, and perfect continuity is obtained by means of special fixtures provided.

NEW APPARATUS AND APPLIANCES

Socket for Large Incandescent Lamps

The "mogul" socket shown herewith is of the brass-shell type and is designed for use with nitrogen-filled incandescent lamps. The device is rated at 1500 watts at a pressure of 600 volts. It can be provided with a shade holder, which is permanently attached or not, as desired. Caps of two sizes are employed, the diameter

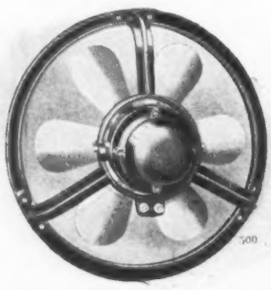


BRASS-SHELL SOCKET FOR LARGE-SIZED INCANDESCENT LAMP

of one being ⅜ in. and that of the other ½ in. The shell and cap are fastened together by means of a screw thread and held in place by a steel set screw. The device is finished in brush brass and is being placed on the market by Harvey Hubbell, Inc., Bridgeport, Conn.

Exhaust Fan with Inclosed Motor

The accompanying illustration shows an exhaust fan with motor fully inclosed recently developed for use in spraying booths. The fan removes from the booth the vaporized air and objectionable odors which arise from the spraying materials and which are injurious to the health of the operator. The body casting and the front and rear heads are made solid, and they prevent the spraying materials which are drawn to the motor by suction from accumulating on the working parts and affecting the operation of the motor. The motor can also be used for any class of service where protection is necessary, and especially where the air contains grease, grit, acids and other substances which are injurious to the windings and commutator of the motor. Both 12-in.



EXHAUST FAN FOR SPRAYING BOOTHS

and 16-in. fans are being made, and the motors operate on direct current and alternating current. The 12-in. fan has an air displacement of 1500 cu. ft. to 2000 cu. ft. of air per minute, while the 16-in. fan displaces from 2200 cu. ft. to 3300 cu. ft. per minute. The fans are being placed on the market by the Robbins & Myers Company, Springfield, Ohio.

Transformer Fuse Block

In the fuse-block for high-voltage operation shown herewith the fuse link is carried between two blocks of limestone which are held together by two springs. When the fuse blows the molten metal is immediately flattened out to a non-conducting state by the 14-lb. pressure of the springs. The rapid quenching of the arc, due to an action somewhat similar to that of the oil in an oil switch, together with the absence of air pockets, makes the amount of gas generated insignificant, preventing any possibility of explosion. The tendency for the re-

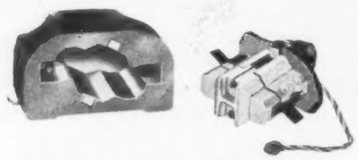


FIG. 1—TRANSFORMER FUSE BLOCK AND PLUG

FIG. 2—COMPLETE TRANSFORMER CUT-OUT

movable plug to be blown out is also avoided. The barriers shown in the sectional view also assist in quenching the arc and increase the effective air-gap. The latter advantage is of special value when men are working on a "dead" transformer.

Thin strips of metal alloy, cut by dies, form the fuse elements. These fuse strips are inexpensive, and by reason of the relatively great length of working material in the fuse link, the exclusion of air currents, the restricted radiation of heat and the liberal area of contacts the fuses are extremely accurate in operation. The blocks themselves are formed of glazed porcelain and are very substantial. Such a block as that illustrated is capable of withstanding the explosive effects incidental to interrupting 1000 kw or more, at 2400 volts.

At small cost these fuse blocks may be shunted with horn-gaps for protection in sections where lightning conditions are severe. The practice of installing lightning arresters on the same poles as grounded transformer cases has resulted in an increase in the number of fuse blocks destroyed, but the use of the horn-gap device referred to has, it is declared, reduced to a negligible quantity some of the worst troubles of the kind reported from the severest thunder zones of the Middle West.

Protection against the entrance of moisture and smoke is afforded by the absence of breathing action in these fuse blocks. The fuse strips are also covered with

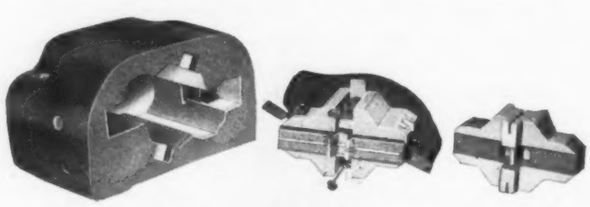


FIG. 3—PLUG DISASSEMBLED, SHOWING FUSE

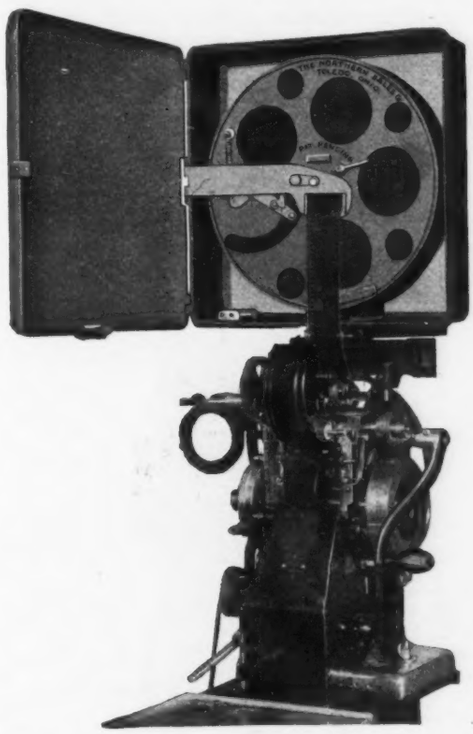
enamel which guards the metal against corrosion. The plug handle is so proportioned that it can be grasped firmly by the lineman when wearing rubber gloves. A wide shield affords the operator protection should the cut-out be replaced while a short circuit exists. To prevent the plug falling to the ground while out of the block the handle is provided with a cord by which it is

held while the fuse is being renewed or while the lineman goes elsewhere hunting trouble.

To meet especially destructive atmospheric conditions, the Chemelectric Company, 4327 Kenmore Avenue, Chicago, maker of the "S. & H." fuse block above described, has also brought out an oil-filled fuse block in which the porcelain and current-carrying parts are entirely submerged in oil while the entire block is inclosed in a strong metal case. Several of these oil-filled fuse blocks have been in service for several years in industrial districts. Their use is recommended in the vicinity of gas works, ore crushers and unloaders, mines, smelters, etc. The cut-out is being placed on the market by the G. & W. Electric Specialty Company, 6306 Blackstone Avenue, Chicago, Ill.

Electrically Operated Motion-Picture Reel

A method by which a motion-picture film may be drawn from the inside of the reel rather than from the outside, thus eliminating the need of rewinding the film by hand, has recently been devised. The apparatus developed is shown in the accompanying illustration. The outside face of the reel is stationary. The inside face and the spool around which the film is rolled are removable and are geared to a small motor through a magnetic clutch. The film passes from the reel over a movable roller which is connected to a small switch. When the film becomes taut the switch closes, the magnetic clutch is energized, and the reel is revolved by the motor, thus loosening the film. When the film becomes sufficiently loose the switch opens and the reel stops revolving. Thus the film is fed out at just the right rate of speed, it is declared, and never becomes so tight as to break or so loose as to tangle.

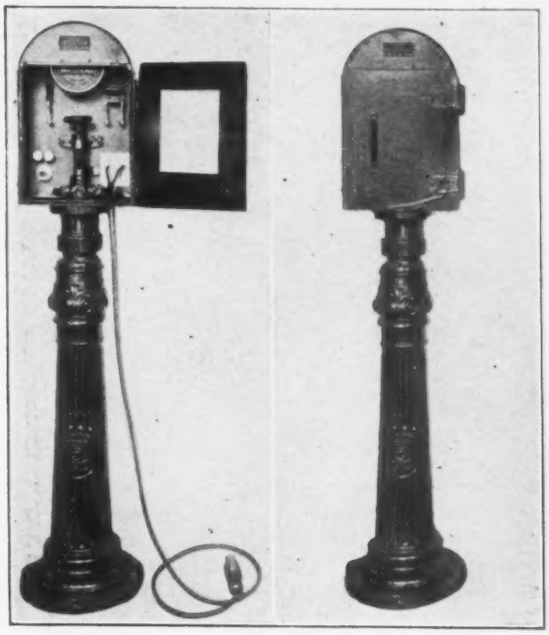


APPARATUS FOR ELECTRICALLY OPERATING MOTION-PICTURE REEL

The apparatus is being placed on the market by the Northern Sales Company, Toledo, Ohio, and the motor used in its operation is made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Public Electric-Vehicle-Charging Station

A compact charging station for electric automobiles, which is inclosed in a weatherproof box and is mounted on a pedestal so that it can be placed near the curb, is shown in the accompanying illustration. A charging cable and plug are provided, and while the battery is being charged the door can be closed and locked. A regulating rheostat, ammeter, polarity indicator, lamp, switches, etc., are mounted on a slate panel as shown in Fig. 1. The box is of sheet steel and is electrically welded. The pedestal is of cast iron. Connection with the direct-current supply is made through conduit passing underneath the sidewalk. A prepayment meter may be used if desired, but on account of the numerous sizes and kinds of batteries and varying conditions an attendant is usually required.



FIGS. 1 AND 2—CURB CHARGING STATION FOR ELECTRIC AUTOMOBILES

This device for charging electric cars at the curb is made in two sizes with ratings of 100 amp and 150 amp and is being placed on the market by Clarence E. Ogden, 514 Mercantile Library Building, Cincinnati, Ohio.

Garage Floor Lamp

The fixture shown in the accompanying illustration is designed for garage use and is equipped with a heavy cast-iron base 22 in. in diameter. The device is also provided with heavy telescopic brass tubing by means of which the height of the lamp can be adjusted from 3.5 ft. to 6 ft. A reflector is provided for the lamp cluster, and the lamps are protected by a heavy guard. The reflector is attached to the upright by a swinging joint, so that it can be tipped up or down or swung in any direction. The fixture is equipped with 20 ft. of waterproof cord and a two-piece plug. The complete weight of the device with its various appurtenances is 25 lb.

The stand described above is being manufactured by Frank W. Morse, 516 Atlantic Avenue, Boston, Mass.

Electric Internal Grinder

An electric grinder designed for grinding gasoline-engine cylinders, air cylinders, etc., has been developed by the Standard Electric Tool Company, Cincinnati,

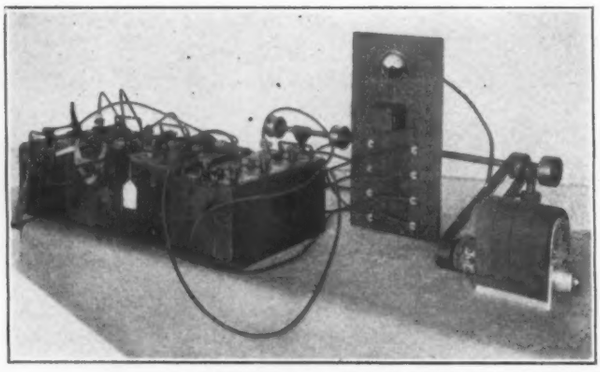
ELECTRIC GRINDER

Ohio. An attachment is provided so that the grinder can be fastened to the tool post of a lathe. A universal motor operating on both alternating current and direct current operates the grinder. The emery wheel is 3.5 in. in diameter and has a 1-in. face. Ball bearings are used throughout. The weight of the tool is 35 lb.

Small Battery-Charging Outfit

A dynamo for charging 6-volt and 12-volt batteries has been developed by the Esterline Company, Indianapolis, Ind. The dynamo is equipped with a pulley which can be belted to a line shaft driven by an electric motor. It is fully inclosed to keep out dust and dirt and is fitted with large-sized ball bearings running in oil. Dynamos with ratings of 12 amp and 18 amp are being made.

The switchboard has been provided with an ammeter and an automatic switch for connecting the batteries to the generator and for disconnecting them in case the generator should for any reason be shut down. Provision is also made on the board for connecting four

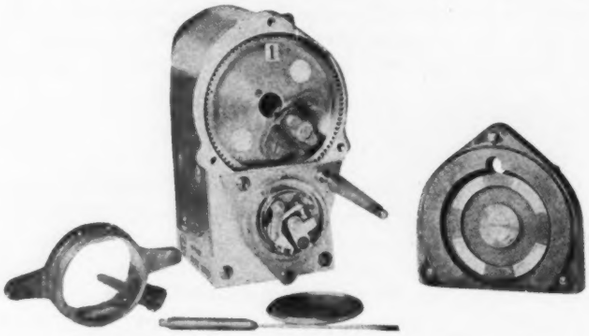


AUTOMOBILE BATTERY-CHARGING OUTFIT

batteries to the dynamo at one time. The switchboard is 10 in. by 20 in. and can be mounted on the wall or near to the wall. All permanent connections are made in the rear of the board and the battery connections on the front of the board.

Gas-Engine Magneto

A magneto designed for use on internal-combustion engines has been developed by the British Thomson-Houston Company, Ltd., Rugby, Eng. The device is equipped with a base and end plate of aluminum and is completely inclosed. A small opening in the top of the magneto covered with fine gauze is provided so that air can reach the armature, thereby dissipating any vapors which may be formed. The magnets are of tungsten steel. For safeguarding the armature insulation in



EXPLODED VIEW OF GAS-ENGINE MAGNETO

case the voltage rises to an abnormal value a spark-gap is provided.

In the accompanying illustration is shown an exploded view of a magneto designed for use on motor cycles. The high-tension slip-ring is on the left of the armature, and the condenser on the right. The end cover on the extreme right of the illustration shows the arrangement of the high-tension terminal, which is waterproof. The magneto is made in three models, a small type being used for single-cylinder motor cycles and two larger sizes for use on four-cylinder automobiles.

Electric Bench Drill

The motor-driven bench drill shown herewith is equipped with a movable table 6⅝ in. in diameter and a fixed table 6.75 in. wide by 7.5 in. long. The drill is belt-

ELECTRICALLY OPERATED BENCH DRILL

connected to a ⅛-hp motor operating at 1750 r.p.m. The belt is 1 in. wide and may be tightened by thumb-screw adjustment. The switch is at the side of the drill press as shown in the illustration. The weight of the device is 60 lb. and the height is 22 in. The maximum dis-

tance from chuck to the movable table is 8 in. and maximum distance from chuck to fixed table is 13.5 in. The distance from the column to the spindle is 4⅜ in. Spindle speeds of 925 r.p.m. and 2900 r.p.m. can be obtained. The head, with motor attached, can be lowered and swung through 180 deg. so that the drill will clear the base. The drill is being made by H. G. Crane, Brookline, Mass., and is operated by a Holtzer-Cabot motor.

Combination Switch and Meter Protective Device

Because of the movement to inclose and to protect the various energy-carrying parts of a circuit, an interlocked service switch and meter-protecting device have been developed by the Metropolitan Engineering Company, Brooklyn, N. Y. The switch is shown in the open position in Fig. 1. In this illustration the plug fuses utilized are plainly shown. The switch mechanism can be sealed in the closed or open position, or it may be left unsealed so that the consumer can renew the fuses when they blow out or become defective. Open wiring may be employed in place of conduit when so desired. Use is made of a double-break plunger switch which is actuated by springs. The switch box is provided with knock-outs at both ends and sides, and several sizes of conduit may be employed. At the top of the box provision is made for a metallic cover for the conductors leading from the box to the meter. This cover or "adapter," as it is called, is made in various sizes to take various types of meters. In Fig. 2 the meter and its protecting device and the switch in the closed position are shown. The box is locked and the switch cannot be tampered with.

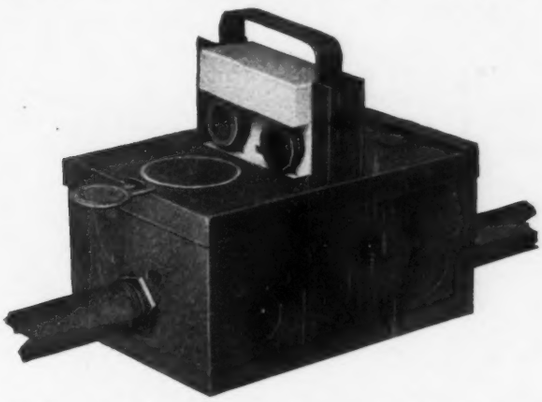


FIG. 1—INCLOSED SERVICE SWITCH IN OPEN POSITION

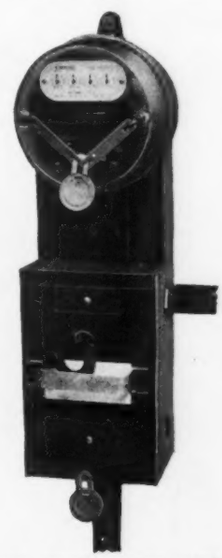
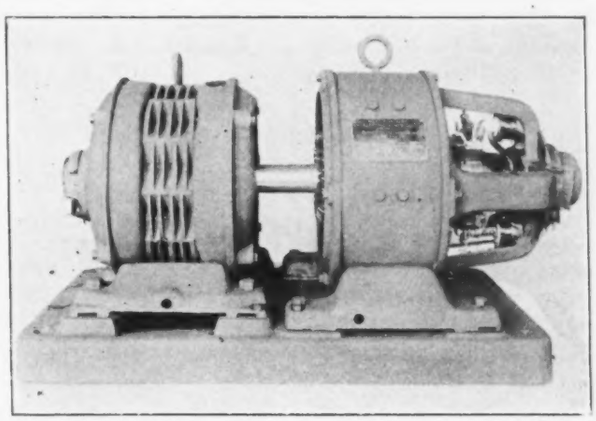


FIG. 2—METER AND PROTECTING DEVICE AND INCLOSED SWITCH IN LOCKED POSITION

Motor-Generator Set for Motion-Picture Service

A motor-generator set designed for motion-picture service is shown herewith. The set will supply sufficient energy to feed the arcs of two moving-picture machines at one time, such an operation often being necessary where two reels are used and it is designed to maintain continuous service. The generator is designed to give an emf of 75 volts at all loads, the manufacturer declares, so that there will be a drop of 25 volts in the ballast resistor, leaving a potential of 50 volts for the arc. The outfit has been developed by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.



MOTOR-GENERATOR FOR MOTION-PICTURE APPARATUS

Portable Alternating-Current Volt-Ammeter for Signal Systems

A portable volt-ammeter designed for use in testing alternating-current railway signal systems has just been placed on the market by the Roller-Smith Company, 203 Broadway, New York. The instrument is inclosed in an oak case which is provided with a leather handle, hinged cover and snap catch. Use is made of heavy binding posts having non-removable tops and a zero adjuster conveniently placed for manipulation. Each binding post is marked with a numeral corresponding to the

FIG. 1—ALTERNATING-CURRENT VOLT-AMMETER

scale value obtained when that binding post is employed. A feature of this instrument is the method of indicating by diagrams on the scale, as shown in Fig. 2, the ranges

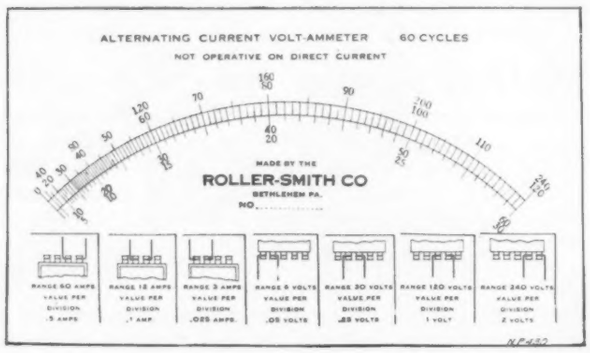


FIG. 2—DIAL OF VOLT-AMMETER

and data covering the values for each scale division. The instrument is calibrated for the frequency on which it is used. The dimensions are 6⅞ in. by 7 in. by 4¼ in., and the weight is 7 lb.

Electric Grinder and Drill

The electrically operated grinder shown in Fig. 1 is of the tool-post or center type. The grinder may be provided with a slide or used without one as desired. Improved bearings have recently been developed for the grinder so that accurate work can be produced. There is no tendency, the manufacturers declare, for the armature shaft to crowd into the bearings. The device operates on alternating current or direct current at pressures of 110 volts or 220 volts as desired.

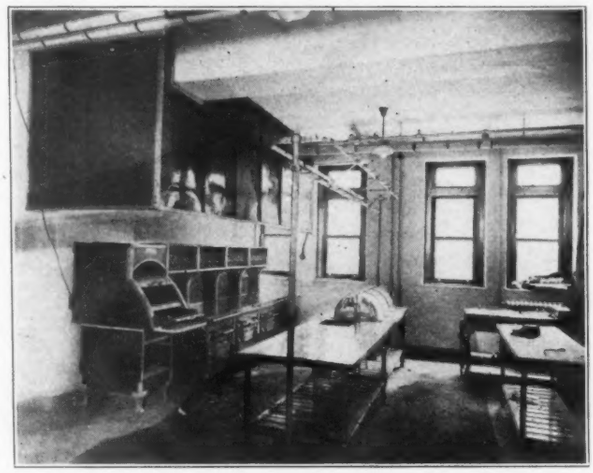
In Fig. 2 is shown an electric breast drill also recently placed on the market. The switch is conveniently placed in the handle. The diameter of the body is 5⅜ in. and the height above the chuck is 13 in. The drill may be used with alternating-current circuits or direct-current circuits. The weight of the alternating-current device is 22 lb., and that of the direct-current device is 20 lb. Holes with diameters up to ½ in. can be drilled in iron or steel and up to 1 in. in wood. A Jennings bit is employed with the drill. The reduction gears are designed so that the power is transmitted equally from opposite points of each gear.

The drill shown in Fig. 3 is a two-speed, two-spindle device and is provided with screw feed and a breast plate. It may be equipped with an alternating-current or direct-current motor as desired, operating on 110 volts or 220 volts. A Jacobs chuck is used with the No. 1 spindle, which can be used to drill holes up to ½ in. in diameter. The No. 2 spindle can be utilized for holes up to ¼ in. in diameter. The maximum speed of the former is 450 r.p.m. and that of the latter 225 r.p.m.

The tools described above are manufactured by the Stow Manufacturing Company, Binghamton, N. Y.

Electric Cooking Installation in Hospital

The large-sized electric range and boiler shown herewith were recently installed in Mount St. Mary's Hospital, Niagara Falls, N. Y. The range is equipped with four ovens and is constructed with the necessary baffles and insulated walls and doors. The top plates are of polished steel. Use is made of both high-heat and low-heat units which are arranged in series so that both the top plates and the ovens may be operated either jointly or independently of one another.



ELECTRIC KITCHEN IN HOSPITAL

The installation of the electric cooking apparatus described above was made by the Bernard Gloekler Company, Pittsburgh, Pa.

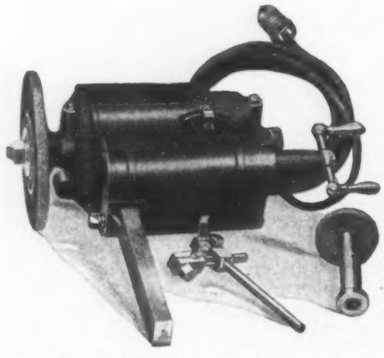


FIG. 1—ELECTRIC TOOL-POST GRINDER

FIG. 2—ELECTRIC BREAST DRILL

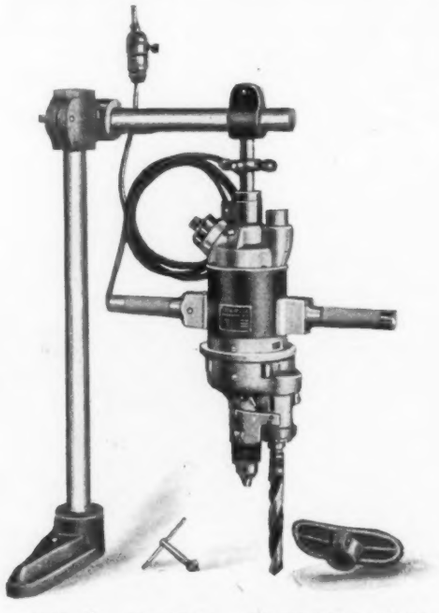


FIG. 3—ELECTRIC TWO-SPINDLE DRILL

CURRENT NEWS SECTION

A National Electrical Week

The success which attended the celebration of Edison day, coupled with the rapidly growing impulse of the electrical industry to express itself and exploit the possibilities of service to the public, has caused a good deal of quiet discussion in the last few months. This discussion has gradually produced a sentiment in favor of a nation-wide celebration, preferably a celebration throughout an entire week next fall. On the call of Mr. J. M. Wakeman, general manager of the Society for Electrical Development, a meeting was held at his office in New York City on Friday, Jan. 8, attended by publicity men and representatives of manufacturers, central stations, jobbers, contractors, dealers and trade and technical journals.

As a result of its deliberations the meeting decided to recommend to the board of directors of the society the inauguration of a vigorous sales and educational campaign during the week of Oct. 18, 1915. The plan contemplates the co-operation of all affiliated interests in the electrical industry with national manufacturers and with civic bodies to promote the better lighting of streets, stores, factories, schools and homes, all with the aim to show how general business in each community may be advanced by the larger use of electricity in all its applications.

Those present at the meeting, in addition to Mr. Wakeman and his staff, were Messrs. L. D. Gibbs, Edison Electric Illuminating Company of Boston; E. W. Lloyd, Commonwealth Edison Company of Chicago; H. K. Mohr, Philadelphia Electric Company; George Williams, Henry L. Doherty & Company; F. H. Gale, General Electric Company; J. C. McQuiston, Westinghouse Electric & Manufacturing Company; W. D. Lindsey, Western Electric Company; W. H. Tapley, Crocker-Wheeler Company; Elliott Reid, Westinghouse Lamp Company; H. E. Dawson, Edison Lamp Works; J. R. Strong, Tucker Electric Construction Company; Hugh M. Wilson, ELECTRICAL WORLD; H. C. Cushing, *Central Stations;* N. W. Gage, *Electrical Record;* Norman Macbeth, *Lighting Journal,* and E. E. Whitehorne, *Electrical Merchandise.*

Among the suggestions made as to ways and means of promoting the plan was to enlist the co-operation of the Jovian Order and other electrical societies and associations, and of national advertisers who might use their space in the magazines to arouse the interest of the public and to get their customers to make special window displays during electrical week; the co-operation of mayors and other functionaries of towns and cities; the co-operation of boards of trade, chambers of commerce and like civic organizations; the inauguration of "white way" lighting and similar attractions to bring people into the cities; a campaign on the part of electrical contractors to encourage all merchants to increase greatly their window illumination and display during the week; activities on the part of central stations in the way of offering prizes for the best lighted stores, best display of electrical merchandise, best illumination of displays of other merchandise, as well as liberal advertising campaigns in local newspapers prior to and during the electrical week; parades of electric vehicles, floats, etc. It was suggested also that the society prepare special posters for billboard and other use to be sold at cost to those desiring to use them in advertising the carnival, prepare special literature for distribution by central stations, supply dealers, contractors and others, arrange for lectures, special meetings, articles in trade papers, newspapers, popular magazines, etc.

If the board accepts the suggestion, a special committee will probably be appointed to take charge of the work under the direction of the general manager of the society, sub-committees and local committees all over the United States and Canada taking charge of the details.

Electrical Manufacturers to Organize

Acting on the suggestion of the special committee of electrical interests at a meeting in the Hotel Biltmore, New York, on Jan. 12, representatives of various electrical manufacturing companies met in the same hotel last Tuesday afternoon to discuss the formation of an organization of manufacturers whose function it would be to deal with the commercial problems of the industry. Mr. R. K. Sheppard, of the B. F. Goodrich Company, Akron, Ohio, who was chairman of the special committee of electrical interests from which the suggestion emanated, was chosen chairman of the meeting, and Mr. H. R. Sargent, of the General Electric Company, secretary.

Although the situation arising over the activity of the lighting companies in pushing consideration of a grounded concentric-wiring system was the immediate reason for calling an organization of manufacturers into being, the thought was expressed by many present, notably Messrs. A. W. Burchard, of the General Electric Company, L. A. Osborne, of the Westinghouse Electric & Manufacturing Company, and C. Eidlitz, of the Metropolitan Electric Manufacturing Company, that a manufacturers' organization must have a much broader scope. The Electric Manufacturers' Club and the Electric Power Club were both cited as manufacturers' organizations already in existence and doing excellent work. Neither, however, was large enough or comprehensive enough in organization to meet the situation. It was felt that any new organization should co-operate with both existing organizations so that duplication of work could be avoided.

The discussion centered in the recommendations of the special committee of electrical interests made to the general meeting held Tuesday morning. The three definite recommendations made by the special committee were taken up and voted on. It was decided to place the matter of organization in the hands of a representative committee of nine, which will report to a general meeting to be called later. With reference to the formation of a committee of commercial and technical experts to investigate and pass on the relative efficiencies of the concentric-wiring system and the systems at present in use in this country, it was voted that a committee of five be appointed to draft for the next meeting nominations for such a committee to take in the work outlined in the report at the morning session of electrical interests given elsewhere in this issue.

The proposal to have a publicity committee which would distribute broadcast information obtained on all-insulated systems of wiring and on all-grounded systems of wiring, and which would in addition give out the

findings and recommendations of the committee of commercial and technical experts, was laid on the table by divided vote. It was the sense of the meeting that the committee on organization report at a general meeting to be called on Feb. 9 to which electrical manufacturers from all over the country would be invited.

Accounting Section for the N. E. L. A.

The accounting committee of the National Electric Light Association met in New York on Jan. 12. Mr. H. M. Edwards, the chairman, presided. Definite steps were taken toward the organization of an accounting section of the association. By-laws were framed and will be filed with the executive committee of the N. E. L. A. for approval. It is proposed to conduct the section as an internal organization within the N. E. L. A. rather than as a separate association. As this form of organization is experimental and the committee had no rules to serve as a precedent, the extent to which the new section will be autonomous was not worked out. After the approval of the executive committee of the main body the new section will be ready to complete its organization as to officers and work at the June convention, at which Pacific Coast conditions will be dealt with.

Members of standing committees were appointed. The committee discussed the question of interdepartmental charges. This was referred to the committee on the uniform system of accounts with the idea that it shall be taken up with similar bodies in other classes of utilities so that uniform progress may be made in the distribution of interdepartmental charges. It is proposed to call attention through a notice in the N. E. L. A. *Bulletin* to the organization of a question-box committee which will promote the consideration of accounting questions through that publication.

Water-Power Legislation in Congress

The Senate committee on commerce has reported a substitute for the Adamson water-power bill, and the Senate committee on public lands has reported the Ferris water-power bill with a number of changes.

Mr. Gifford Pinchot, president of the National Conservation Congress, has issued a statement in Washington attacking the substitute for the Adamson bill. This substitute Mr. Pinchot calls "the Shields bill," because the name of Senator Shields is attached to the report on the Adamson bill. The Adamson bill was stricken out by the committee and a new bill written. Mr. Pinchot says, in part:

"The Shields bill ostensibly provides for a method of terminating the water-power grant at the end of fifty years. As a matter of fact, it appears to have been carefully drawn so as to make it practically impossible for the United States to resume its rights. The Shields bill gives to the water-power interests the right to condemn any land, public or private—a right which they should never have."

Patent Office Congestion

On Jan. 5, 1915, there were issued by the United States Patent Office 1033 patents, the largest number ever issued in one week. The accompanying table shows that in some respects the congestion in the Patent Office is greater than it has been for many years, new cases in some divisions being badly neglected in favor of old cases.

On Jan. 1, 1907, the Patent Office was less than two months behind on new amended cases, and there were only 10,674 applications awaiting Patent Office action. On Jan. 12, 1908, the office had fallen over five months behind on new work and four and a half months behind on amended work in some divisions, and 18,540 cases were awaiting action. The conditions improved somewhat during 1909 and 1910, but since then they have become rapidly worse except in old cases. Action on old cases is now very prompt—some being taken up within a week or ten days. Some examiners are now very strict in admitting amendments in old cases and are inclined to give final action even when amendments of a substantial character have just been made, the idea being to close the prosecution at once.

Twenty-two divisions out of forty-three under which the work is conducted are now less than one month behind on amended cases and seventeen are less than two months behind. The four others are less than three months behind on old work. On new work two divisions are about ten months behind on some cases. One division is nine months behind; two, eight months; three, seven months; nine, over six months; three, over five months; three, over four months; twelve, over three months; one, over two months; four, over one month, and three are about one month behind.

CONDITION OF APPLICATIONS IN PATENT OFFICE

Year	Number of Patents Issued	Number of Applications Filed	Applications Awaiting Action of Patent Office on Dec. 31	Months Behind on Oldest Cases Awaiting Action on Dec. 31	
				New	Amended
1910	35,168	63,293	15,617	3.5	3.0
1911	32,917	67,370	18,344	4.0	3.0
1912	36,231	68,968	27,865	7.3	6.0
1913	33,842	68,117	31,891	8.3	4.5
1914	39,946	70,000*	22,036	10.0	2.6

*Approximated.

The printing of the patents has been so greatly delayed that the record of electrical patents dated Jan. 5, 1915, which should have appeared in this issue of the Electrical World, has had to be postponed for one week.

Federal Trade Commission as a Tariff Commission

President Wilson's announcement in his Indianapolis speech that he believes that the Federal Trade Commission which is soon to come into existence has the powers, duties and responsibilities of a tariff commission has created a profound impression among leaders in Congress. Members of the finance committee of the Senate and of the ways and means committee of the House of Representatives take the President's words to mean that there may be a revision of some schedules of the tariff during the present administration.

It is said in Washington that unless such a revision were in mind there would have been no reason why President Wilson should lay such emphasis on the probable tariff-making powers of the commission. The disclosure in Washington, following the President's speech, that it was Representative Underwood, now chairman of the House ways and means committee, and as such one of the leaders in framing the present tariff law, who was responsible for the phrases in the Federal Trade Commission law under which the President says the commission will be so empowered has lent strength to the belief that a revision of some of the tariff schedules is at least contemplated.

The President's views as to the powers of the Federal Trade Commission still further explain the very great care and amount of time he is devoting to selecting members of the commission. It is readily understood in Washington that if President Wilson is obliged to look into the tariff opinions of possible members of the commission, in addition to other opinions which possible members may hold, he has a much larger task in selecting the commission than was at first supposed. Some progress has been made in regard to composing the differences of opinion between Senators and the White House over appointments to public office.

Mr. Joseph E. Davies, Commissioner of Corporations, and Mr. Dudley Field Malone, Collector of the Port of New York, have introduced to President Wilson former Representative Alfred Lucking, of Detroit, Democratic candidate for Senator two years ago against Senator William Alden Smith, of Michigan, as a possible appointee to the commission.

Further Discussion on Concentric Wiring by Electrical Interests

On Tuesday of this week there was a meeting of the general committee of electrical interests at the Hotel Biltmore, New York City, to hear the report of the special committee appointed Dec. 22 to confer with the sub-committee on concentric wiring appointed by the National Fire Protection Association. As stated in these columns last week, the former committee met with the sub-committee of the Underwriters on Jan. 1. After a thorough presentation of the case by Mr. R. K. Sheppard, the sub-committee on concentric wiring, of which Mr. W. H. Blood, Jr., is chairman, offered to modify the proposed preamble which it had drawn up for presentation at the March meeting of the National Fire Protection Association at which changes in the National Electrical Code will be considered. The preamble as revised is as follows:

Grounded Concentric Wiring Systems

"The committee reports progress and desires to be continued for further investigation of the subject. As a matter of information, at the present time, however, the following statements and a set of suggested requirements illustrating the rules for one possible form of system are presented.

"The committee does not at this time recommend these or any rules for concentric wiring for inclusion in the National Electrical Code, but recommends that this report in full be filed with the secretary of the electrical committee of the National Fire Protection Association and with the Underwriters' Laboratories, Inc., and that by them copies of it may be furnished upon request to applicants therefor.

"The interest in a system of grounded concentric wiring has arisen chiefly from two considerations—first, a desire for a system of wiring possessing advantages of low cost, ease of installation and good appearance; second, a desire to protect persons against injury by the use of a grounded system having no ungrounded exposed carrying parts.

"It is the intent of the following suggestions and illustrative rules to prescribe only for possible experimental and development purposes the general conditions for a system of grounded concentric wiring. These illustrative rules are, therefore, only a partial outline of possible furture requirements and are subject to revision, modification and extension resulting from further information and experience when such is obtained. A system which fulfils the condition outlined below and no more will not necessarily be acceptable, and suggestions for the further development of similar systems and the requirements applying to them are invited. All appliances and systems should be submitted to the Underwriters' Laboratories for inspection and report."

In the opinion of the special committee of electrical interests the proposed preamble with rules drawn up by Mr. Blood's committee, if it were adopted by the National Fire Protection Association, would, whether so intended or not, permit such free use of the authority to place in service trial installations that the system would promptly find commercial uses beyond the possibility of control by the inspection departments of the National Board of Fire Underwriters or inspection departments of other governing bodies either national, state or municipal.

Committee of Business and Technical Experts Recommended

Mr. R. K. Sheppard, as chairman of the special committee, also formulated and presented for consideration specific suggestions looking to the ultimate, wisest solution of the entire problem of concentric wiring as his committee saw it. Acting on the suggestion of Mr. H. R. Sargent, a member of the sub-committee on concentric wiring, the special committee of electrical interests recommended that for the purpose of studying rapidly and thoroughly both the present practice of all-insulated circuits and, coincidently, the principle of grounded-return circuits, and endeavoring to produce something better, the electrical manufacturers appoint a representative committee of business and technical experts, possibly including in its personnel representatives of research and development departments of manufacturing and other enterprises, including the Underwriters' Laboratories and the National Electric Light Association.

The committee suggested that to that committee the industry should intrust: First, the determination of the relative efficiencies of the two systems, (a) as to safety to persons, (b) as to protection against fire, (c) as to the possible provision of methods of wiring at low cost, combined with ease of installation and sufficiently attractive appearance to obtain popular approval; second, the presentation to the entire industry of the results of its investigation, in the form of concrete recommendations including standard systems, standard devices and standard appliances.

Publicity Committee Suggested

The second suggestion of the special committee was that the electrical manufacturers be requested to appoint a publicity committee to search out, obtain and publish in the trade journals and through other suitable mediums as many facts as can be discovered having either an interesting or an important bearing on the subjects "Concentric Wiring," "All-Insulated Return Circuits for Interior Wiring of Structures in America" and "All-Grounded Return Circuits for Interior Wiring of Structures in America." It was also suggested that to this publicity committee the proposed representative committee of business and technical experts be directed by the electrical manufacturers to deliver frequently for publication in the trade journals and through other suitable mediums full accounts of the progress of the investigations, stating results obtained and, as rapidly as formulated, the recommendations which ultimately will be assembled into the final, complete report of the representative committee of business and technical experts to the electrical manufacturers.

Manufacturers' Organization Urged

The third specific suggestion of the special committee pertained to organized co-operation throughout the electrical industry, to be arranged only in complete com-

pliance with the laws of the land, both federal and state. The committee pointed out that the central-station interests have the National Electric Light Association, the fire-insurance companies of the country their National Board of Fire Underwriters and their National Fire Protection Association, the electrical jobbers their Electrical Supply Jobbers' Association, the electrical contractors their National Electrical Contractors' Association, and that apparently the manufacturers are not now equipped with the machinery for concerted action. The committee suggested the wisdom of immediate consideration of this problem by the manufacturers then present.

Assuming that an association of manufacturers can be satisfactorily maintained under federal and state laws, a direct and prompt return from a proper organization into a working body of the many different sections of the manufacturing branch of the electrical industry was described to the committee by Mr. W. H. Merrill, manager of the Underwriters' Laboratories, Inc. More than 1000 factories included in fully 100 different industries in the United States are working with and are served by the laboratories. Of those 100 odd industries several already are enjoying the abundant benefits of the different industry conferences organized by the Laboratories. The rubber-insulated wire manufacturers participate therein through the rubber-covered wire-industry conference. To those industry conferences the Laboratories present for consideration all matters which have or may have, directly or indirectly, either favorable or adverse effects on the portion of the industry involved. Manufacturers so equipped with their proper industry conference are assured of positive control against hasty or ill-advised action by the Underwriters' Laboratories, Inc., or by other authorities who depend upon the laboratories for investigation of the problems which confront them from time to time.

The Resolution

As a terse embodiment of the co-operative spirit with which the Underwriters' Laboratories, Inc., will welcome an organization of the manufacturers, the committee presented the following resolution:

"Whereas, conference committees made up of representative committees of manufacturers and representative committees of Underwriters' Laboratories have been appointed from time to time to serve the interests of a number of sections of the electrical industry, and whereas, the practical results obtained through the operation of these conferences have been of decided benefit to the sections served,

"Be it resolved, that a committee be empowered to take the steps necessary to secure the appointment of a conference committee representing the industry as a whole which may deal with those broader questions affecting manufacturers in more than a single line."

There was quite a discussion on the report of the special committee, and Mr. Sargent, of the General Electric Company, who explained in detail the Stannos wire and the study made by him of its use in England, was plied with questions of all sorts on its cost, characteristics, etc. The report of the committee was accepted and the committee was continued as well as the larger committee of twenty-six of which Mr. C. Eidlitz is chairman.

The attendance was quite large, and in view of the recommendations of the special committee that the manufacturers organize for concerted action it was suggested by Mr. C. E. Corrigan, of the National Metal Molding Company, that a conference of manufacturers be held in the afternoon of Jan. 12 to discuss the subject. An account of that meeting is printed elsewhere in this issue.

United Gas Improvement Company Investigation

Mr. George Carroll Todd, assistant to the Attorney-General, characterizes as inaccurate reports which have been published to the effect that the Department of Justice has completed an investigation of the business of the United Gas Improvement Company of Philadelphia and that the government is to institute a suit against the company under the Sherman act.

Mr. Todd informed a representative of the ELECTRICAL WORLD in Washington this week that it is true that an investigation has been conducted, "which has resulted in a very substantial amount of information being gathered" in regard to the company, but that it is not proper to say that it has been completed. So far as the government's intentions are concerned, these, he pointed out, are never revealed in advance of any action it may become necessary to take.

Washingtonians familiar with the procedure of the Department of Justice point out that any difference of opinion which may arise between the Department of Justice and the company would, in the ordinary course of events, be the subject of negotiation between the department and the counsel for the company, to seek the basis of an agreement whereby the company would not continue to do business which had been the subject of complaint that might, in the view of the department, if supported by evidence, show the business to be contrary to the Sherman law. Such agreements usually result in the filing of a decree agreed to in advance by counsel, as was the case with the incandescent lamp companies several years ago.

It is stated at the Department of Justice that the investigation of the company has been the result of complaints of alleged combination in the lighting of streets, principally in connection with the using of appliances of the Welsbach company, shipped back and forth from one state to another under circumstances, complainants alleged, contrary to the Sherman law.

Meeting of N. E. L. A. Executive Committee

A meeting of the executive committee of the National Electric Light Association was held at the headquarters in New York on Jan. 8, and a great deal of business was transacted.

The financial report as of Dec. 31, 1914, was presented. Running expenses for the year 1914 were $93,321. Convention expenses, including publication of the *Proceedings*, were $29,490, making a total of $122,-811. The revenue from fixed dues was $83,892. Miscellaneous revenue from the sale of publications, etc., was $25,511; revenue applicable to convention expenses was $26,924, making a total revenue of $136,327. The surplus for the year was $13,516. The total balance-sheet surplus on Dec. 31, 1914, was $19,732.

Mr. J. B. McCall, chairman of the finance committee, submitted a schedule of the proposed dues for manufacturing members, which was adopted.

Mr. Douglass Burnett, representing Mr. E. L. Callahan, chairman of the Commercial Section, submitted the budget of the Commercial Section for the year ending June 30, 1915. Mr. Burnett said that for three years, through the committee on the education of salesmen, the section has been considering the question of the establishment of courses for the education of salespeople, especially for all of those engaged in commercial work. He had a report from Mr. F. R. Jenkins, chairman of the education committee, indicating that a tentative program has been prepared with the idea that if the plan receives the approval of the executive committee of the main body and the executive com-

mittee of the Commercial Section, the committee will prepare a course which will be self-supporting. The course prepared by the National Commercial Gas Association for employees of gas companies was mentioned, and it was suggested that many of the educational principles of this course and of the proposed course for employees of electrical companies might be the same and that a great deal of expense and work might be saved if the two associations should co-operate. Mr. Burnett said that this would be done. The committee approved the plan with the understanding that it should be self-supporting.

Standardizing Plugs and Receptacles

Mr. R. S. Hale, chairman of the committee on wiring of existing buildings, presented a report on standardizing plugs and receptacles, which has been approved by his committee and the executive committee of the Commercial Section. The report will be presented at the convention in June, but Mr. Hale asked that it be published at this time so that it may have discussion before the convention. The report will be published in advance. Mr. Hale spoke of the movement in connection with concentric wiring, stating that one manufacturer has a system partly worked out which might take at least a year to get on the market. After some discussion the following resolution was adopted:

"The executive committee believes that the central-station industry is vitally interested in any reduction of the cost of wiring that will be safe and approves the action of the committee on wiring of existing buildings and of the insurance expert in taking steps toward the development of wiring systems with this in view. The executive committee believes that while changes should not be made a permanent part of the Code without due consideration, yet that proper action should be taken as soon as possible so as to warrant manufacturers, contractors and central stations in acquiring actual field experience of any promising development."

A membership report as of Jan. 8 was presented, showing a total membership amounting to approximately 12,000.

The following committee was appointed to attend the convention of the National Foreign Trade Council to be held in St. Louis, Mo., on Jan. 21 and 22: Messrs. A. C. Einstein (chairman), W. A. Layman, M. A. Oudin and Maurice Coster.

Mr. W. H. Blood was authorized to submit to the Underwriters the rules regarding bare concentric wiring as proposed by the committee on that subject when the committee shall have completed the rules.

At the request of President Scott, Secretary T. C. Martin made a statement as to the general condition of preparations for the convention to be held in San Francisco on June 7 to 11. Mr. George W. Elliott, master of transportation, made an extended statement regarding the transportation plans and the four special trains to be run from the East. Mr. Martin and Mr. Elliott started the last of this week for California in order to make further plans in connection with the convention.

President Scott stated that the ELECTRICAL WORLD had tendered its services in connection with the *Daily* to be issued at the San Francisco convention but had suggested that, in view of the attractions at the exposition, the little leisure for reading and other incidental reasons, it might be better this year to publish the *Daily* in more condensed form. The offer was accepted unanimously with thanks. The *Daily* will be limited largely to registration lists, committee lists, the daily program of sessions and entertainments and general official announcements.

Testimony of Mr. Sidney Z. Mitchell on the Water-Power Bill

Testimony on the water-power bill has been presented before the committee on public lands of the United States Senate at Washington by Mr. Sidney Z. Mitchell, president of the Electric Bond & Share Company, and also by a number of others. An abstract of Mr. Mitchell's testimony follows:

The object of the bill, as Mr. Mitchell takes it, is to remove the handicap to power development which now exists wherever any government land is involved and to secure for the people the greatest commercially practicable development of water-powers in the least possible time and on a basis which will secure permanently for the people a maximum of service at a minimum of cost. With this theory Mr. Mitchell is heartily in accord. There seems to be a notion that all water-power is cheaper than steam-power and that water-powers are exceedingly scarce and accordingly are in every case of immense value and that investors are eager to get into the business. All of these notions are fallacious. In some cases water-power is much cheaper than steam. In many cases the reverse is true. Each case must be analyzed and considered in the light of surrounding circumstances. Contrary to the general notion, water-powers are, as a rule, large and numerous in the Western States. Yet it is far from easy to persuade investors to put money into them. It is entirely right that the Secretary of the Interior should be able to remove obstructionists who do not go ahead and make actual developments within some reasonable time, which should be specified in permits. After the investment has been made the slightest impediment, beyond the restrictions of the States themselves, to the transferability and salability of any property by public utility concerns will do great harm to financing. Obstructions to the ready sale and purchase of securities always increase the cost of money for initial development and subsequent extensions.

Mr. Mitchell said that the section regarding provision for obsolescence will be the most dangerous clause affecting the whole matter of water-power development if it is passed as contained in the bill. There may be a great many charges that could be amortized in four or five years and perhaps in less time. On the other hand, there will be a situation where it would be a physical and absolute impossibility to collect from the consumers any rate which would amortize the charges in ten years, or possibly in fifteen or even twenty years. The people of the West do not like anything that raises their rates. They do not want to have them disturbed at all unless they are disturbed downward. The way to make a provision for amortization or increased profit is not by raising rates but by, first, getting cheaper money and, second, cutting down operating expenses and, third, getting more volume. This stabilizes the business and makes securities marketable, thus giving cheaper money again in almost direct proportion to the volume and diversity of use and again reducing the cost of money in almost inverse ratio. This again gives cheaper operation in direct proportion to the volume and diversity of business, which again means cheaper money and lower consumers' rates, etc.

Looks for Volume of Business

The way to get volume is to look for it, if necessary in another state, continued Mr. Mitchell. Credit would be affected instantly if a company had only one line of business in one community that depends on one industry and that industry should be shut down. Instead of that, the Utah system covers 1400 miles of high-tension line. It is in three states. It is agreed that farmers

should diversify. There are many more reasons why power companies should diversify. A market is more important than the water-power. Money and market are the first two things to get. Water-power is secondary because steam can be put in at many places. The Utah company acquired a number of small companies having many small hydroelectric plants. Some of the plants were comparatively new, and yet the operating and maintenance expenses per unit of output of these plants, which were thought to be perfect eight or ten years ago, were in one case just a little more than twenty times the similar cost of the same items at the new plant at Grace, Idaho. This is an extreme case. Some of the others were about ten times.

Mr. Mitchell cited an instance of development in Texas where his company furnished capital two years ago for the establishment of a rural power business. About forty towns and villages are served. Many small communities did not have electrical service at all. Some had no service later than midnight. Very few plants were operated in the daytime. Some towns did not have as high a load factor as 10 per cent. A few had about 7 or 8 per cent. The highest did not exceed 30 per cent. In the last eighteen months there have been built in that territory over 200 miles of high-tension transmission lines. Nearly 100 miles of additional transmission line are under construction now. By tying the plants together and diversifying the load the company is getting an average load of 71 or 72 per cent. During the first summer season, when twenty-four-hour rural service was given, about 5000 fans were sold in seventy days. In addition to that, cotton gins throughout the belt were connected. Mr. Mitchell said that he had not the slightest doubt that inside of five or ten years, certainly before twenty years, there would be a network of wires covering the black land belt entirely, 250 miles by 150 miles, affording service for nearly every farmhouse and rural community in the district.

Water-Power Plentiful

Mr. Mitchell added that the known amount of available water-power will be growing constantly just as the estimate of available coal supply has been growing. Where there are mountains, rain or snow, reservoir sites and elevations of land there are water-powers. Somebody with a little creative genius and experience will find them. In comparisons of the cost between water-power and steam-power it must be borne in mind that the water-power costs are practically all interest, maintenance, taxes and obsolescence. The steam-power costs are mostly fuel, labor, taxes and obsolescence. The water-power may have a handicap due to the long transmission line as compared with steam near customers. Mr. Mitchell said that in discussing costs per horse-power it is important to know the conditions. The investment is based on the highest peak load at any time within the year, and it is this load for which the company must make the investment.

If the proposed federal tax was not intended as a revenue measure, there is no possible excuse for it. The idea that the federal government is levying a personal tax on the plant output in order to reduce the cost to the consumer is, of course, too absurd to be considered seriously by anybody. The bill goes far beyond a particular project built wholly or partially on government land, and undertakes to reach out and depreciate the values underlying millions of dollars' worth of other property which may have been in private ownership for years and has absolutely nothing to do with any new development on government land beyond a connection by transmission lines. In effect it seeks to coerce investors in existing property to give the government an option on their property for fifty years or longer. Options given are not assets, they are clouds on the titles, they are liabilities. The bill attempts to force an option to take over old, well-established and very valuable property under less fair conditions than those which are already guaranteed under the constitution of the country.

A Service, Not a Commodity

If any law is made to cover interstate electric business, Mr. Mitchell said that he hoped it would be a general law applying to all power companies alike, no matter where they are situated or how the power is generated. He also hoped that if such a law were made it would be prepared very carefully so as to provide for the inherent differences between electrical power and freight and other commodities whose shipments are regulated by the Interstate Commerce Commission. There may be a power line in one state that runs into another state, and the modern tendency is growing very rapidly toward having three or four or five states interconnected and interchanging power with each other. Mr. Mitchell spoke of interconnected properties in the South which have a total of about 1200 miles of transmission line. It is not a matter of common ownership, but the properties have interchange power contracts. In the case of electrical energy transmitted between different states both generation and selling proceed in each state, and it is impossible to tell where any particular power originates. Electricity is not a commodity, it is a service. The time and the rate of speed are frequently much more important than the amount of the service.

In showing that every public service concern is inherently a monopoly in the particular field which it serves exclusively, Mr. Mitchell said that competition with such a property would have an exact parallel if every railroad train had a duplicate mail car and two sets of railway mail employees and every town two post offices and two sets of mail carriers.

On the subject of regulation of security issues, Mr. Mitchell said that some of the people who are in favor of such regulation are influenced a good deal because sometimes bond houses send out circulars stating that the securities have been passed upon by the public utility commission of a state. That merely puts a brand of respectability on the securities. There is no guarantee as to the actual physical value back of them, how good they are, or as to how marketable they are going to be. It is not possible to get cheap money and plenty of it unless there are both the brand of respectability and the brand of quality. Respectability means only that the people are honest in putting out the securities and that they have told the truth as they saw it. It does not mean that the securities have been investigated thoroughly and have the approval of the most experienced and successful houses that always dig below the surface of things. It does not mean at all that the securities are safe and profitable. The best way to get cheap money is not to put too much store upon yield and speculative values. It is a great deal better to be conservative and understate rather than overstate the facts.

Obstacles to Water-Power Development

Continuing, Mr. Mitchell said that his experience has been that the three greatest obstacles to water-power developments, especially for other than extensions of the business of existing companies, are (1) the present unworkable laws where government land is involved, (2) the difficulty in securing capital, which with wholly new enterprises is greatly increased by regulation especially of security issues, and (3) lack of market. He has never known of so great a change and, in fact,

almost universal about-face in financial practice as has occurred in public utility financing by the best investment houses during the last eight or nine years. This change has been particularly marked during the last two or three years and has been influenced to a large extent by the modern methods of public utility regulation.

Undoubtedly, the regulation of security issues by commissions has had an effect upon the financing of entirely new enterprises. There are some operators, particularly of the old school, who say that there is nothing left in the utility business, that it no longer offers a profitable field for pioneering with wholly new enterprises. On the other hand, there are others who are still optimists, who believe that if the companies will put all their cards on the table face up and be frank and open in every respect with the public and with the legislators, a square deal will be given, and that the investors who devote their money to the service of the people under regulation will have their investment protected by law and will certainly be allowed to earn enough on their money to induce them to continue to furnish money for the service of the public. Mr. Mitchell is in the optimistic class.

One thing is certain, said Mr. Mitchell. In the public utility business shoestring methods of finance and fancy profits, which were usually promised but seldom realized, are absolutely a thing of the past. With such a close limit of profit no one can afford to pioneer in a way which exposes him to large losses. The only way to make money in the public utility business to-day is by following the idea which involves large volume of business, low cost of operation, low cost of money, low rates to consumers and small margin of profit. Under the old plan a water-power pioneer did not balk at losing 40 or 50 per cent on one risky hydroelectric enterprise provided he could make a quick profit of 15 or perhaps 20 per cent on another such enterprise. Now that it is impossible to make a return of more than 8 or 10 per cent in any enterprise, it has become absolutely essential to proceed with the greatest circumspection and care to avoid making losses on any of them.

The essentials in investment in the order of their importance are: (1) safety of principal; (2) safety and consecutiveness of yield; (3) marketability; (4) amount of yield; (5) possibility of enhancement in market value.

The possible injustice and, if the law is made mandatory, the probable certainty of confiscation, in the interest of the government or some subsequent lessee, of a substantial portion of the initial investor's principal in these properties is the most disturbing feature of the entire bill. Mr. Mitchell expressed the hope that the bill will so be changed as to limit discretionary powers of government officials to matters of engineering details or administration; that as to all essential matters of title or business the law shall be made as plain and as specific as it is possible to write it. Investors in water-power securities, where government land is involved, are particularly sensitive at this time as to the question of tenure. The revocations by the federal government and pending ejectment suits are matters of common knowledge and have resulted in widespread skepticism and fear where water-power development on government land is involved.

Integrity of the Investment

The protection of the integrity of the investment is the most important thing in the whole bill. Powers can be developed only if legal rights under the terms of the law are made as secure and clear and fair as any other investments on privately owned land. The companies will never require less capital but will constantly, year by year for all time, require in an ever-increasing ratio more capital. For this reason amortization of the capital is a financial impossibility, particularly for fixed-term tenures, without the imposition of rate burdens on consumers, which in most cases they cannot possibly stand. No power company or other public utility can, over a long period, take care of its cash requirements for obsolescence and for an average growth of 12 per cent or more out of its net earnings and at the same time pay one cent of interest or dividends. Many of them cannot grow 6 per cent a year and do it. This means that new capital must be secured constantly.

Any unfair treatment of the utility by governmental agencies increases the hazards of the business and results necessarily in an increase in the yield which the man with money will insist upon receiving if further funds are to be provided. This means one of three things: (1) The rates will be raised; (2) reductions in rates which would otherwise be made will be deferred, or (3) no more money will be forthcoming to take care of the growth of the community. In any event it is the consumers who suffer.

Where operating companies show exceptional zeal and ability in extending the power systems, improving the service and lowering the rates they should be allowed to earn a little extra compensation. If this policy should be adopted by commissions generally, it might offer a strong probability of enhancement in prices of utility securities and thus add to them an increased or prospective value to be realized, provided only that the company earns it through good conduct and efficiency. There are many cases in which consumers will be repaid manyfold by holding out an inducement of this kind as an incentive for exceptional personal effort and ability in public service.

The rate of expenditure to take care of the ordinary growth in the public utility business, more than $400,000,000 a year now, is increasing by leaps and bounds. There is not the slightest doubt that within the next seven or eight years the expenditures for such improvements and extensions will amount to at least $800,000,000 and in fact they may amount to $1,500,000,000 a year.

If this bill is passed as drawn, Mr. Mitchell expressed the opinion that it is quite likely that but little, if any, money will be obtained for power developments where public land is involved, and if money is obtained from the public at all for such purposes it will be very difficult to obtain and will certainly cost not less than 2 per cent per annum more than would be the case if investors were protected adequately. There are many utility properties to-day representing cash investments in excess of $40,000,000, and within the next twenty years Mr. Mitchell expects to see dozens of utilities with properties which have cost in cash in excess of $100,000,000.

Others Who Testified

Among others who testified were Messrs. G. M. Dahl, vice-president Electric Bond & Share Company; F. T. Homer, of Bertron, Griscom & Company, New York; John D. Ryan, president Montana Power Company; Frank H. Short, San Joaquin Light & Power Corporation, and George A. Snow, Salt Lake City, Utah; Governor Spry of Utah; Mr. O. C. Merrill, chief engineer of the Forest Service of the Department of Agriculture; Governor Ammons of Colorado, Governor-elect Carlson of Colorado, United States Senator Shafroth of Colorado, Representative Mondell of Wyoming, and United States Senator Jones of Washington. Mr. Franklin K. Lane, Secretary of the Interior, wrote a statement of his views.

Miscellaneous News Notes

Binghamton Municipal Bonds Not Approved.—The municipal plant bonds issued by the city of Binghamton, N. Y., and sold to a New York banking house have not been approved by the attorneys of the city on legal grounds and the transaction with the bankers has been canceled.

Temporary Injunction in Cincinnati.—The Diamond Light Company of Cincinnati has secured from Judge Oppenheimer of the Superior Court a temporary injunction to prevent the Union Gas & Electric Company, the John C. Weber Company and the John Hauck Brewing Company from interfering in any way with its feed wires.

Developments in Cleveland Situation.—City Solicitor John N. Stockwell of Cleveland, Ohio, appeared before the Ohio Supreme Court on June 7 in the suit of the city to enjoin the board of sinking-fund trustees from selling $500,000 electric-light bonds at less than par, and asked a review of the case, which was brought from the Court of Appeals from Cuyahoga County. The case was brought to determine the right of the sinking-fund trustees to sell the bonds at less than par. The city of Cleveland will install 550 new ornamental street lamps, but the time when this will be done depends somewhat upon the condition of finances. Director of Public Service Sidlo says that an additional appropriation may be made.

Extension of Baltimore Underground System.—The Electrical Commission of the city of Baltimore, Md., installed last year 1,600,000 duct ft. of conduit at a construction expense of $576,391. This also included 682 house connections, 194 pole connections, 68 trolley-pole connections and 643 arc-lamp connections. In connection with the conduit construction there were erected 237 manholes, 35 junction boxes and 269 distributing boxes. Since the beginning of the underground conduit system construction the commission has removed from the streets approximately 9000 wooden poles. The total number of feet of underground cable in use on the first of the year was 3,360,870 ft. The city's revenue from rentals from the system was $135,522 last year.

Lease for Rights on State Property Cannot Be Revalued.—Attorney-General Timothy S. Hogan of Ohio has rendered an opinion that the lease of the Union Gas & Electric Company of Cincinnati for pole-line rights along the banks of the Miami & Erie canal within the limits of Hamilton County cannot be revalued. The company is paying $600 a year for the rights. Under an act of 1911 the part of the canal within the limits of Cincinnati was turned over to the city to be used for boulevard and subway purposes. As the company is allowed to maintain its lines along the city streets free of charge, it was thought that the rental might be reduced somewhat. The Attorney-General, however, says that when this property was turned over to the city reservation of the rights of the company was made and it has been protected. Therefore, there is no reason for a reduction in the rental.

Portraits by Electric Light Without Negatives.—Mr. A. Werner, of Cleveland, Ohio, has produced a photographic paper on which portraits may be reproduced directly without the preparation of the usual negative. Experiments made by light from tungsten lamps at Camp Nela, Cleveland, indicate that the paper operates at about the same speed as the plates ordinarily used for portraiture. The time required for developing is only a few minutes, so that the paper is well suited for the uses of photograph galleries where pictures are made ready "while you wait." For operation by the light of tungsten lamps the paper is treated with a dye which makes it particularly sensitive to the yellow rays of the tungsten filament. Mr. Werner is now developing an emulsion for his paper which will be suitable for X-ray work, thus enabling the X-ray operator to obtain positive prints immediately and without the trouble and expense of the intermediate negative. The principle underlying the preparation of the positive print is the dissolving away of the negative image and the reversal of the residual positive image, making it alone visible. This operation does not correct, of course, the original right-and-left reversal of the lens, and pictures made with the paper are therefore mirror images of the original.

Associations and Societies

Heating and Ventilating Engineers.—The Association of Heating and Ventilating Engineers will hold its annual convention at the Engineering Societies Building, New York City, Jan. 20 and 21.

National Independent Telephone Association.—The annual convention of the National Independent Telephone Association will be held at the Hotel LaSalle, Chicago, Feb. 3, 4 and 5. The headquarters of the association are permanently at Room 244, Hotel LaSalle.

Missouri Electrical Contractors.—A meeting of the Electrical Contractors' Association of the State of Missouri will be held in Kansas City on Jan. 23. It is probable that efforts will be made to bring about the passage of a State law requiring the licensing of persons engaged in electrical construction work. Mr. A. J. Burns, Kansas City, Mo., is secretary of the association.

Electrical League of Cleveland.—More than 200 members of the Electrical League of Cleveland and their friends were present at the "watch party" held in the league rooms at the Hollenden Hotel on New Year's Eve. Professional and amateur vaudeville acts were given during the evening. At 12 o'clock the party drank a "dry" toast to the new year. Only water and coffee were served.

Chamber of Commerce Meeting.—The annual meeting of the Chamber of Commerce of the United States will be held at the New Willard Hotel, Washington, D. C., on Feb. 3 to 5. A large part of the program will be devoted to foreign trade, the elimination of undue restrictions, the upbuilding of the merchant marine and the aid that can be rendered by the Federal Reserve Board. The business legislation enacted recently will be discussed thoroughly. Secretary of Commerce Redfield will address the convention.

Chicago Electric Garage Owners to Join Chicago Section, E. V. A.—The Chicago Electric Garage Owners' Association has voted to include its own membership with that of the local section of the Electric Vehicle Association of America. Since the constitution of the latter organization will not permit the affiliation of the garage men's association as a body, the sixteen members voted to join as individuals. Mr. T. B. Lillie has been president of the electric garage owners' association, and Mr. J. E. Rhodes has been secretary.

Western Efficiency Society.—At the annual meeting of the Western Efficiency Society, Auditorium Hotel, Chicago, Jan. 8, Mr. G. C. Dent, of the Delta Electric Company, 72 West Adams Street, Chicago, was re-elected secretary-treasurer, and Mr. J. F. Henning, Chicago surface railways, was named as a director. The society was formed about two years ago by Chicago interests to promote efficiency in commercial, financial, public-service and industrial organizations. A number of electrical men are members. Meetings are held semi-monthly.

Chicago Jovians.—Messrs. E. N. Hurley, of Chicago; T. H. Bibber, of New York City; Ell C. Bennett, of St. Louis, and H. E. Niesz and W. R. Pinckard, of Chicago, spoke at the meeting of the Chicago Jovian League on Jan. 11. Mr. E. N. Hurley, the speaker of the day, told of the trip he had made to South America with the Illinois Manufacturers' Association and reiterated the statements he has made many times to the effect that American merchants should seek broader markets so that their business may be less affected by domestic business depressions.

Battery Maintenance Systems in Europe.—Mr. E. W. Lloyd, general contract agent of the Commonwealth Edison Company, Chicago, addressed the local E. V. A. section, Jan. 5, on the subject of "Battery Maintenance Systems and What We Can Learn from European Experience." The speaker ascribed the total absence of electric pleasure cars in Berlin to the different social conditions surrounding well-to-do German women in comparison with American women users of electric vehicles. A review of Mr. Lloyd's observations in Europe was presented in the ELECTRICAL WORLD of Aug. 15, 1914, shortly after his return from abroad.

Western Society of Engineers.—The letter-ballot election of officers of the Western Society of Engineers, Chicago, resulted as follows: President, Mr. William B. Jackson, of the firm of D. C. & W. B. Jackson; vice-presidents, Messrs. C. B. Burdick, hydraulic engineer, and Prof. P. B. Woodworth,

head of the electrical engineering department, Lewis Institute; treasurer, Mr. C. R. Dart, Sanitary District of Chicago. Mr. O. P. Chamberlain was elected a trustee for three years. The annual meeting and dinner of the society was held at the Auditorium Hotel, Chicago, Jan. 13, and on Jan. 14 a smoker was held in the society's rooms in the Monadnock Block.

Meeting of Brooklyn Company Section, N. E. L. A.—A pictorial review of the past year's business of the Edison Electric Illuminating Company of Brooklyn by Mr. T. I. Jones, general sales agent, was the feature of the January meeting of the Brooklyn Company Section held Jan. 12. The work done in residences with the company's house-wiring plan, on public streets, in manufacturing plants of every description, and in subway construction, was illustrated and described, as well as its effect on the revenue of the company during the year. The gross business done in 1914 was very satisfactory. Mr. W. F. Wells, vice-president and general manager of the company, spoke on the 1915 outlook, which to him appears to be laden with promise of commercial activity and of increasing business for Brooklyn. The meeting was opened with a paper by Mr. T. W. Flowers on "Central Station Auditing," which was very generally discussed.

Wisconsin Electrical Contractors' Association.—The Electrical Contractors' Association of Wisconsin will meet at Milwaukee, Wis., Jan. 18 to 20. Open sessions will be held on Jan. 19. In the morning Mr. H. P. Andrae, Julius Andrae & Sons Company, Milwaukee, Wis., will speak on "The Jobber in the Field," and Mr. D. Elmer Roberts will discuss "The Contractor in the Field." At the afternoon session Mr. L. G. Morgan, National X-Ray Reflector Company, Chicago, will discuss the subject of "Illumination from Concealed Sources," and Mr. Earl A. Anderson, National Lamp Works, Cleveland, Ohio, will describe "The Incandescent Lamp Developments of 1914." At the time of the informal dinner in the evening Mr. William T. Goffe will speak. At 1:30 p. m. next day, Jan. 20, Mr. C. R. Kreider, Kohler Brothers Company, Chicago, will speak on the subject of "Estimating." Mr. Albert Petermann, 626 Lloyd Street, Milwaukee, is secretary.

A. I. E. E. Panama-Pacific Convention.—On account of the indefinite postponement of the International Electrical Congress, which was scheduled for San Francisco in September, 1915, the American Institute of Electrical Engineers will hold a Panama-Pacific convention in San Francisco during the week beginning Sept. 13, 1915, in conjunction with the International Engineering Congress, which will be held during the week beginning Sept. 20, 1915. This congress has been organized under the auspices of five national engineering societies, namely, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers. Since the A. I. E. E. constitution requires that the annual convention be held each year prior to Aug. 1, the annual convention will be held in the East, at some place not yet selected, during the latter part of June.

"Question-Box" Convention for New England Section.—President L. D. Gibbs of the New England Section of the N. E. L. A. is completing plans for a "Question Box" convention at Boston, Mass., on March 9 and 10, 1915, with headquarters at the new Boston City Club building, Ashburton Place and Somerset Street. On the first day there will be an informal discussion of central-station problems without scheduled papers or addresses, with a visit to the Boston Automobile Show in the evening. The second day will be devoted to discussing electric-vehicle matters, with particular reference to central stations and co-operation, and the meeting will close with an evening assigned to the general discussion of traffic regulations as affecting the growth of electric-vehicle service and sales. It is planned to eliminate "red tape" to the last possible degree, and the convention, while taking the place of the annual "get together" spring meeting of the section, is designed to combine opportunity for good fellowship with an intensely practical business program.

Society for Electrical Development.—A meeting of the staff of the Society for Electrical Development, Inc., was held at the offices of the society at 10 a.m. on Friday, Jan. 8, at which members of the various sections reported on their work during December. These monthly meetings are held for the purpose of keeping all members of the society's staff posted upon its activities and of developing the team work of the organization. Mr. George B. Muldaur, reporting upon the work of Section 1, called attention to the fact that every city of 100,000 population or more in the country has been visited by representatives of the society during the past four months. Since the last meeting Mr. H. C. Spaulding has resigned, being succeeded by Mr. H. W. Alexander. Miss Grace T. Hadley since Jan. 1 entered upon her duties in charge of the publicity work of the society dealing with household electrical devices, and particularly with the work intended to appeal to the women users of such devices. On the afternoon of the same day the staff of the society met with a number of representatives of members for the purpose of discussing among other things the plans for a proposed national electrical week to be celebrated in October next.

Ohio New-Business Men to Meet at Cleveland.—A meeting of the committee on new-business co-operation of the Ohio Electric Light Association will be held at the Hotel Hollenden, Cleveland, Wednesday, Jan. 20. Following an address by Mr. Mathias E. Turner, of the Cleveland Electric Illuminating Company, at 10 a. m., Mr. T. E. Simpers, of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., will read an illustrated paper on "Applications of Electric Drive in Flour Mills." After luncheon Mr. W. A. Wadsworth, of the Union Gas & Electric Company, Cincinnati, will speak on "Securing Business with the Nitrogen-Filled Lamp." A representative of the General Electric Company will discuss "Applications of Motors up to 25 Hp," and Mr. J. G. Matthieu, power engineer of the Dayton Power & Light Company, will read a paper on "Industrial Trucks." Mr. Thomas F. Kelly, Dayton Power & Light Company, is chairman of the committee. A general invitation is extended to central-station men and manufacturers to attend these meetings. A conference of meter men of the Ohio Electric Light Association is scheduled for Zanesville on Jan. 22. The session will be held at the Chamber of Commerce, beginning at 1 p. m. Mr. J. L. Wright, Toledo, is to read a paper on "Diplomacy of Meter Men in Dealing with the Public," and Mr. Wilford Judy, Newark, will describe "Some Common Mistakes in Meter Connections."

Midwinter Convention of the A. I. E. E.—The midwinter convention of the American Institute of Electrical Engineers will be held in New York on Feb. 17, 18 and 19. The tentative program calls for six technical sessions. At the morning session of Feb. 17 Prof. E. E. F. Creighton, Schenectady, N. Y., will present a paper entitled "High-Frequency Testing of Insulators." Written communications on this subject will be submitted by Messrs. A. O. Austin, Barberton, Ohio; J. E. Way, Columbus, Ohio, and Frank Brookfield, New York. At the afternoon session the following papers will be read: "Carrying Capacity of Cables in the Soil," by Mr. L. E. Imlay, Niagara Falls, N. Y.; "Circuit-Breakers," by Mr. K. C. Randall, East Pittsburgh, Pa.; "Comparison of Calculated and Measured Corona Loss Curves," by Mr. F. W. Peek, Jr., Schenectady, N. Y., and "A 100,000-Volt Portable Substation," by Mr. C. I. Burkholder, Charlotte, N. C., and Mr. N. Stahl, Pittsburgh, Pa. There will be a discussion on the status of the engineer at the evening session in which a number of prominent engineers have promised to take part. At the morning session on Feb. 18 there will be papers on "The Distortion of Alternating-Current Wave-Form Caused by Cyclic Variation in Resistance," by Mr. E. C. Mayer and Prof. Frederick Bedell, Ithaca, N. Y.; "Dimmers for Tungsten Lamps," by Mr. Alfred Waller, Bronxville, N. Y., and "Searchlamps," by Lieut. C. S. McDowell, Brooklyn, N. Y. During the afternoon of Feb. 18 it is planned to visit the 201st Street station of the United Electric Light & Power Company and other places of engineering interest. Friday morning's session will be devoted to a discussion of the electrical precipitation of smoke and dust. A historical sketch on these subjects will be followed by one devoted to theory, and a third will relate to the commercial precipitation of dust, fumes and smoke. The discussion at the final session on Friday afternoon will relate to motor applications.

Public Service Commission News

Ohio Commission

The hearing on the appeal of the Union Gas & Electric Company of Cincinnati from an ordinance ordering extensions of lines to annexed territory, which was to have taken place on Jan. 7 last, has been continued, counsel for both the city and the company having agreed to the step. The company, it seems, is now extending its service to Delhi, Sayler Park and Fernbank, as the ordinance specified, and there seemed to be little need of going further with the hearing.

In the case of the Mahoning County Light Company the commission has decided that it has no authority to prevent other light companies from entering into competition with existing companies. In the final decision it was pointed out that the Legislature vested in the commission authority to maintain a regulated monopoly in the case of only telephone companies. In case the Legislature had intended to extend this authority to light and power companies, the fact would have been expressly stated in the law, according to the opinion of the commission.

New Jersey Commission

In 1914 the commission investigated 606 complaints, many of which were settled without formal hearings. The number of formal complaints heard was 456, one of them requiring twenty-seven days to hear. There were fifty-nine applications for the issue of securities granted, the par value of the securities involved amounting to $88,106,750. There were forty-nine sales of public utility properties and eighty-two petitions for approval of ordinances granting privileges to utilities approved. There is now under way a valuation of the properties of the Public Service Electric Company, to be used by the commission in its investigation of rates. In referring to the decision of the Court of Appeals in the 90-cent gas case the commission recommends that consideration be given to the advisability of amending the law so that it shall clearly appear, as the legislative intent and as an authoritative declaration of State policy, that the board in fixing just and reasonable rates to be charged by a public utility shall not value the franchise of such utility in excess of the amount the commissioners find to have been legitimately spent in procuring it.

The board recommends legislation clearly conferring on the board power to put into effect classifications and classes of rates, so that it cannot be contended that the board's power is limited to the regulation of existing rates and classifications of rates. Another recommendation is that the board be empowered to require proof, when its approval to proposed security issues is asked, that there has been adequate attempt on the part of the petitioners to ascertain and to obtain the highest price at which such securities may be sold.

California Commission

The Railroad Commission of California has been advised by Mr. Bela Gati, manager of the Royal Hungarian Post experimental station, that the report of the joint committee on inductive interference has been translated into French, German and Hungarian. Mr. Gati reports that much interest has been manifested in Europe in the work of the committee, and he proposes the formation of a permanent international organization for the study of inductive interference.

The personnel of the new Railroad Commission of California, which took office on Jan. 4 under appointments from Governor Johnson, is the same as heretofore with the exception of Mr. Frank R. Devlin, who was named to fill the vacancy caused by the election of Mr. John M. Eshleman, former president of the commission, as Lieutenant-Governor. As now organized the members of the commission and their terms of office are as follows: Messrs. Max Thelen, president, six years; Edwin O. Edgerton, six years; H. A. Loveland, four years; Frank R. Devlin, four years, and Alex. Gordon, two years. Mr. Douglas Brookman has been named as attorney for the new commission, which announces that all present employees will be retained. Mr. Devlin was a member of the State Senate in 1903-05 and was elected judge of the Superior Court of Solono County in 1906. He resigned later to resume the practice of law.

Personal

Mr. J. E. Hughes has succeeded Mr. C. A. Dow (retired) as superintendent of the municipal water light and power plant at Alliance, Neb.

Mr. C. K. Chapin, electrical engineer of the Memphis (Tenn.) Consolidated Gas & Electric Company, has been elected president of the Memphis Jovian League.

Mr. Howard Heathman, who has been connected with the office of the Dayton (Ohio) Power & Light Company, has been appointed commercial manager of the company at Xenia.

Mr. Timothy C. O'Hearn, city electrician of Springfield, Mass., has resigned to accept a position with the Star Electric Company of New York. Mr. O'Hearn will act as New England agent of the company.

Mr. Samuel Insull, president of the Commonwealth Edison Company of Chicago and of other utilities in Illinois, sailed last week from New York for Europe. Mr. Insull expects to return again to this country on Feb. 9.

Mr. A. J. Cole, who has been Chicago sales manager for the Westinghouse Lamp Company, will be transferred to the general offices of the company, New York City, Feb. 1, as assistant to Mr. T. G. Whaling, general manager.

Mr. C. V. Salisbury has been appointed manager of the Columbus and Seymour plants of the Central Indiana Lighting Company vice Mr. G. B. Thomas, resigned. Mr. Salisbury has been connected with the commercial department of the company for some time and will make his headquarters at Columbus.

Mr. John D. Mickle, formerly manager of the Syracuse office of the Westinghouse Electric & Manufacturing Company, has been elected president and general manager of the Chatham (N. Y.) Electric Light, Heat & Power Company. Mr. Mickle was formerly connected with the Deposit (N. Y.) Electric Company and retired from that company after selling out his interest in it.

Mr. Guy E. Mitchell has been appointed manager of the Westfield (Mass.) Electric Light Department, succeeding Mr. Thomas T. Logie, resigned. Mr. Mitchell is a graduate of the Massachusetts Institute of Technology and has had an extended experience in light, heat and power engineering, including service for nine years as chief draftsman in the motive power department of the Boston & Maine Railroad and electrical work on various electric railways in the Berkshire district of Massachusetts.

Mr. Frank E. Watts has been appointed district manager of the Hart Manufacturing Company of Hartford, Conn., with offices at 203 Broadway, New York City. Mr. Watts, who was formerly Eastern manager of the ELECTRICAL WORLD, and who is widely known throughout the industry, has had a rather remarkable career. Born in Sandusky, Ohio, in 1878, he was educated in the public schools of Delaware County, Ohio, Wesleyan University and Ohio Northern University and for eight years followed the profession of teacher. He entered the incandescent-lamp business in 1907 after two years' experience in selling machinery and for some time was manager of the Sunbeam lamp department of the Western Electric Company. While serving in that capacity he was elected Jupiter of the Jovian Order at the meeting in Pittsburgh in 1912. He had already served as statesman of the order for New York. He left the Western Electric Company to join the advertising staff of the ELECTRICAL WORLD. Last November Mr. Watts was appointed first tribune of the Jovian Order for New York City, and the success thus far attending the luncheons of the Jovians in New York is a tribute to his popularity and to his ability in marshaling men.

F. E. WATTS

Mr. Errett L. Callahan, chairman of the Commercial Section of the National Electric Light Association, and for the last six years manager of the new-business department of H. M. Byllesby & Company, Chicago, has resigned his position with the Byllesby company to become Chicago district manager for the Westinghouse Lamp Company. Mr. Callahan's work in organizing and directing the new-business staffs and in building up the gas and electric business served by the Byllesby utility properties has been extremely successful and has been characterized by many original campaigns and sales features which secured quick results. The commercial departments of all thirty-five Byllesby service organizations have been under Mr. Callahan's direction. Although a young man, Mr. Callahan has had a long and varied experience in the electrical industry. He was one of the founders of the Commercial Section of the N. E. L. A., and served it successively as member of the executive committee, secretary, vice-chairman and chairman. He has contributed much effort toward the success of the section and has been a frequent contributor to convention programs and to the technical press. Mr. Callahan is a member of the Jovian Order, the Chicago Jovian League, the Electric Club of Chicago, the American Institute of Electrical Engineers and other bodies. He was born at Scio, N. Y., May 19, 1876, and was educated in the Central High School of Cleveland, Hiram College and the Case School of Applied Science, receiving the degrees of B. S. and E. E. from the last-named. After leaving college Mr. Callahan received a commission in the War Department as electrical expert assigned to work in connection with a proposed submarine cable from Nome to St. Michaels, Alaska. Later he was engaged for two years in the experimental laboratories of the Crehore-Squier Intelligence Transmission Company, and was with the Postal Telegraph Company in experiments with automatic telegraphy between New York and Chicago. In 1902 he joined the staff of Westinghouse, Church, Kerr & Company, engineers, assisting in the electrical equipment of industrial plants and preliminary work on the electrification of the Pennsylvania Railroad terminal at New York. Mr. Callahan next spent four years with the Simplex Electric Heating Company and the Prometheus Electric Company, retiring as manager of the latter to become manager of the heating department of the Chicago district office of the General Electric Company in 1906. Here he originated plans for instructing central-station companies in the pioneer sales work of household electric appliances and quickly acquired a reputation in this particular field, leading to his selection by H. M. Byllesby & Company in 1909 to organize and direct the business-getting department for the properties under its management.

E. L. CALLAHAN

Obituary

Herbert Nicholas Fenner, president of the New England Butt Company, manufacturer of insulated wire and cabling machinery, died Jan. 5 at his home in Providence, R. I., in his seventy-second year. Mr. Fenner was born in Providence on March 13, 1843, and succeeded his father in the New England Butt Company. He served as treasurer of that concern for many years, and at the time of his death was president. He was also a director in the Industrial Trust Company and the Joslin Manufacturing Company. He was a member of the American Society of Mechanical Engineers, the Agawam Hunt, the Audubon Society of Rhode Island, the Providence Chamber of Commerce, the Hope Club, the Providence Art Club, the Rhode Island Country Club, the Rhode Island Historical Society, the Rhode Island School of Design, the Squantum Association and the Turk's Head Club, and a director of the Puritan Life Insurance Company.

Corporate and Financial

Federal Light & Traction Elects Director.—Mr. Guy P. Gannett has been elected a director of the Federal Light & Traction Company of New York.

San Joaquin Light & Power to Renew Notes.—The San Joaquin Light & Power Corporation has been authorized by the California Railroad Commission to renew $92,500 notes.

Idaho Electric Properties Assessed Value.—The twelfth biennial report of the State auditor of Idaho gives the assessed valuation of electric utilities as $6,274,308 in 1913 and $10,520,362 in 1914, an increase of 68 per cent.

Southern California Edison Bond Offering.—Harris, Forbes & Company and E. H. Rollins & Sons are offering $518,000 general mortgage 5 per cent bonds of the Southern California Edison Company of Los Angeles, Cal., at 92.

International Steam Pump Receiver.—Former Judge Gilbert Collins has been appointed receiver in New Jersey for the International Steam Pump Company by Vice-Chancellor Stephenson of New Jersey in the suit brought by Mrs. Ethel Elms of England.

Northern Ontario Light & Power Bonds.—A. D. Converse & Company of New York are offering the unsold portion of an issue of Northern Ontario Light & Power Company, Ltd., first mortgage 6 per cent sinking-fund gold bonds due April 1, 1931, at 88 and interest to yield 6.82 per cent.

Cumberland Edison Company to Issue More Stock.—The Maryland Public Service Commission has authorized the Edison Electric Illuminating Company of Cumberland to issue $200,000 additional stock for the acquisition of more property and the construction and maintenance of a larger plant.

Mexican Electric Light Defers Coupon Payment.—Owing to continued unsatisfactory conditions in Mexico the Mexican Electric Light Company, Ltd., a subsidiary of the Mexican Light & Power Company, has deferred payment of the semi-annual coupon on its first mortgage bonds of the company.

Santiago Gas & Electric to Renew Notes.—The Railroad Commission of California has rendered a decision authorizing the Santiago Consolidated Gas & Electric Company to renew three promissory notes totaling $55,000 held by H. M. Byllesby & Company and bearing interest at the rate of 7 per cent.

Elmira Water, Light & Railway Offering Over-Subscribed.—It has been announced that the issue of first preferred stock of the Elmira (N. Y.) Water, Light & Railway Company, recently offered by Bodell & Company of Boston, has been over-subscribed. The company is a subsidiary of the United Gas & Electric Corporation of New York.

Merchants' Heat & Light to Issue Bonds.—The Public Service Commission of Indiana has granted authority to the Merchants' Heat & Light Company of Indianapolis, Ind., to issue $281,232 of 5 per cent bonds at not less than 85 to provide funds for improvements made since Aug. 31, 1914. The company is also authorized to issue $75,206 stock.

Winnipeg Electric Railway Note Issue.—William A. Read & Company of New York are offering $1,500,000 Winnipeg Electric Railway 6 per cent one-year and two-year gold notes dated Jan. 15, 1915, $750,000 being due on Jan. 15, 1916, and the remainder on Jan. 15, 1917. The one-year notes are being sold at 100¼ and the two-year notes at 100.

Western Canada Power to Modify Mortgage.—The Western Canada Power Company, upon approval of bondholders, has modified the mortgage by which certain lands are released from the lien of the mortgage and has closed the mortgage at $6,000,000, with provision for an ultimate increase to $10,000.000. The step was taken at the request of intending purchasers of bonds.

Tulare County Power Company's New Plan.—At the recent meeting of stockholders of the Tulare County (Cal.) Power Company a plan was arranged whereby stockholders will raise $300,000, taking a mortgage on the entire property of the company, such as is now held by Mr. C. G. Wrightman. The money is to be used in paying off Mr. Wrightman's loan and other advances by private individuals.

Athol Company Granted Stock Issue.—The Massachusetts Gas & Electric Light Commission has authorized the issue of $320,000 additional stock by the Athol (Mass.) Gas & Electric Company to meet the cost of extensions of plant, including the development of steam and hydroelectric stations and the purchase of the property of the Orange Electric Light Company.

Manchester Traction Acquires Stock Control of Nashua Company.—With the approval of the Public Service Commission of New Hampshire the Manchester (N. H.) Traction, Light & Power Company has acquired approximately 94 per cent of the capital stock of the Nashua (N. H.) Light, Heat & Power Company. At present the two companies are being operated separately.

Depew & Lancaster Light, Power & Conduit Company's Mortgage.—The Depew & Lancaster (N. Y.) Light Power & Conduit Company has filed a mortgage for $1,000,000 to the Fidelity Trust Company of New York. The mortgage was given to secure a present loan of about $258,000, to be used in retiring existing obligations of the company and for the improvement of its property.

Cleveland Electric Bonds Sold.—Spencer Trask & Company of New York announce that they have sold $1,000,000 Cleveland (Ohio) Electric Illuminating Company bonds at prices ranging from 99 to par and interest. The block was part of $7,500,000 outstanding first mortgage 5 per cent bonds of an authorized issue of $30,000,000. The bonds are secured by property showing a cost on June 30, 1914, of $17,504,750.

Oro Electric Corporation Officers.—The Oro Electric Corporation of California has elected the following officers: Messrs. Luther J. Holton, president; R. Leo Van der Naillen, vice-president and general manager; W. G. Jack, secretary. The following, together with the president and the vice-president, are the directors: Messrs. A. O. Leuschner, Samuel Shannon, T. J. Lyons, C. M. Smith and F. B. Peterson.

Northern Light, Power & Coal Bondholders to Meet.—Approximately 10 per cent of the bondholders of the Northern Light, Power & Coal Company, Ltd., of Dawson, Yukon Territory, have signified their intention of meeting to consider the removal of trustees under the first mortgage, to appoint new trustees and to take possession on behalf of the bondholders of the company's properties and assets. The meeting will take place Jan. 14.

Philadelphia Company Scrip Dividends.—The Philadelphia Company of Pittsburgh, Pa., has declared a quarterly dividend of 1¾ per cent on the common stock payable in scrip, redeemable at the option of the company on or before Feb. 1, 1918, and bearing 7 per cent interest. The first scrip dividend was paid by the company on Nov. 2, 1914, to mature in eighteen months. The company later redeemed the scrip from holders of ten shares and under at par.

Midland Counties Granted Time Extension on Bond Issue.—The Railroad Commission of California has extended to May 31, 1915, the time in which the Midland Counties Public Service Corporation may issue $275,000 of its first and refunding 6 per cent forty-year bonds to be used in retiring a like amount of bonds of the Midland Counties Gas & Electric Company. The corporation is also granted a similar extension of time within which to issue $546,000 of the same bonds to be used in retiring a like amount of bonds of the Coalinga Water & Electric Company.

South Carolina Light, Power & Railways Increase Preferred Stock.—The South Carolina Light, Power & Railways Company, Spartanburg, has increased preferred stock from 5000 shares to 7000 shares. The proceeds from the additional 2000 shares which are to be offered soon by A. B. Leach & Company of New York will be used to permanently finance $290,000 of improvements, $90,000 of which was paid for out of the earnings of the company. The remaining $200,000 was taken up by a bond issue. These bonds will be retired by the proceeds from the sale of the new preferred stock.

Consumers' Power Company Offers Notes.—H. M. Byllesby & Company, Inc., and William P. Bonbright & Company are offering $100,000 of Consumers' Power Company of Minnesota collateral trust 6 per cent notes due May 1, 1917, at 97¾ and interest, netting 7 per cent. The present offering is a new block of an authorized issue of $3,000,000, of which there is outstanding at present $934,500. These notes are secured by $1,059,000 general mortgage 5 per cent bonds of the company and $87,300 cash deposited with the trustees, which cash can be withdrawn only by the deposit of $109,123 general mortgage 5 per cent bonds.

Havana Electric Railway, Light & Power Notes.—The Guaranty Trust Company of New York is offering at 99 and interest $2,000,000 Havana (Cuba) Electric Railway, Light & Power Company two-year 6 per cent secured gold notes due Sept. 1, 1916. The notes are secured by a deposit of $4,000,000 of the company's general mortgage sinking fund 5 per cent gold bonds due 1954, being the entire amount of the issue outstanding. The company is a consolidation of the Havana Electric Railway Company and the Cia de Gas y Electricidad de la Habana, both American companies. The company recently made an installation of 37,500 kw.

Texas Public Service Bond Offering.—Spizter, Rorick & Company of New York are offering $375,000 first mortgage sinking-fund 6 per cent gold bonds of the Texas Public Service Company, Mount Pleasant, Tex., dated July 1, 1913, and due July 1, 1933, at 103 and accrued interest. Spizter, Rorick & Company bought the bonds a year and a half ago and have held them until the company is able to show net earnings for over twice the bond interest. The proceeds of these bonds have been used to rebuild and largely extend the company's plants in Vernon, Mount Pleasant, Gilmer and Bay City, which constitute the property of the company on which these bonds are now a joint lien. Beginning in 1917, the company will have an annual sinking fund of 2 per cent to purchase these bonds, and this fund will be sufficient to retire over one-half of the bonds by maturity.

Ontario Power Bond Issue.—Blodget & Company, of Boston and New York, are offering at 96 and interest $1,660,000 of Ontario Power Company of Niagara Falls 6 per cent second mortgage convertible bonds, dated Nov. 2, 1914, and due on Nov. 1, 1919. These bonds will be secured by a second and closed mortgage of $5,000,000 on all the property owned. The total first and second mortgages of the company will be about $90 per electric horse-power installed. The proceeds from the sale of the bonds will be used to retire the notes due on July 1, 1915. Bondholders will have the privilege of converting their bonds into the common stock of the company as follows: From Nov. 1 to Dec. 31, 1915, at 80; from Jan. 1 to Oct. 31, 1916, at 85; from Nov. 1, 1916, to Oct. 31, 1917, at 90; from Nov. 1, 1917, to Oct. 31, 1918, at 95, and during the remainder of the time until maturity at 100. The rest of the $5,000,000 second mortgage bonds were taken up by $400,000 of 6 per cent convertible debentures and $2,940,000 of 6 per cent bonds due in July, 1931, of which $60,000 have been canceled by sinking fund.

Pacific Gas & Electric Stock Distribution.—The Pacific Gas & Electric Company of San Francisco, Cal., has issued a statement showing the distribution of 70 per cent of the $12,500,000 issue of first preferred stock as announced Aug. 15, 1914, since which time a considerable amount more has been sold. The $8,750,000 worth of stock was taken by 3495 subscribers, as follows: 1621 subscribers were employees of the company, the par value of whose shares was $548,600; 1162 subscribers were customers of the company, whose shares had a value of $1,325,600; the remaining 712 subscribers were stockholders of the company, the par value of whose subscriptions amounted to $6,875,800. The 1621 employees who subscribed to the issue constituted approximately 40 per cent of the permanent staff of the company. The company has now outstanding approximately $51,000,000 par value of stock, both common and preferred, of which there are 508,592 shares distributed among 5792 shareholders. The following shows the geographical distribution of the stock: Pacific Coast, 3976 shareholders, holding 234,751 shares with a par value of $23,475,100; Middle West, 768, holding 65,874 shares with a par value of $6,587,400; Eastern Coast, 665, holding 165,459 shares with a par value of $16,545,900, and Europe, 383, holding 42,590 shares with a par value of $4,250,900. During the last six months the proportion of the holdings on the Pacific Coast increased almost 10 per cent. Of the total

number of individual stockholders, 3976, or almost 10 per cent, are residents of California.

Public Utility Bonds Gain in National-Bank Favor.—According to the annual report of the Comptroller of the Currency for 1914 the national banks of the country had increased their holdings of public utility bonds on June 30, 1914, 11.05 per cent over June 4, 1913. Public utility bonds represent slightly over 11 per cent of their entire holdings of bonds. Not only did public utility bonds show the largest percentage of increase of any of the classes of bonds, but they showed the largest gross increase, namely, approximately $21,000,000. The holdings of government bonds increased about $7,000,000, or slightly over 1 per cent; state, county and municipal bonds increased less than $1,000,000, or 0.1 per cent, while railroad bonds and foreign securities

CLASSIFICATION OF INVESTMENT SECURITIES HELD BY BANKS ON JUNE 30, 1914

	Total Holdings	Public Utility Bonds	Per Cent Total
State bands (14,512)	$388,300,000	$50,800,000	13.70
Mutual savings banks (634)	1,855,500,000	83,600,000	4.50
Stock savings banks (1466)	1,148,700,000	4,900,000	0.427
Private banks (1064)	16,300,000	1,700,000	10.43
Loan and trust companies (1564)	1,261,300,000	224,700,000	17.82
National banks (7525)	1,914,800,000	218,200,000	11.40
Total (26,765)	$5,584,900,000	$583,900,000	10.43

showed decreases, the former of 1 per cent, or $3,500,000, and the latter of over 27 per cent, or $5,800,000. The total gain in bond holdings was 1.015 per cent, or $28,000,000. Thus the gain in public utility bond holdings was 75 per cent of the total gain. The accompanying table shows the proportion of the total bond holdings of 26,765 banks, making reports to the comptroller, represented June 30, 1914, by public utility bonds.

Preparations Made by German Electrical Companies for War.—The London *Electrical Review* has published abstracts from recent issues of German newspapers showing financial conditions of German electrical companies. With one exception the reports of the companies were for the year 1913-14 and covered mostly periods preceding the war. The Telephon Fabrik A. G. vorm. J. Berliner, Hanover, having regard for foreign investments, made provision for exceptional internal reserve before arriving at net profit, thereby taking full account of any possible deficiency and reducing the dividends from 12 per cent to 10 per cent. The A. G. für Elektricitäts Anlagen, Berlin, which operates central stations and railways, reports favorable results for the year 1913-14, internal reserves having been made to provide for the war situation. The Siemens & Halske Company, after placing £100,000 aside for a special reserve fund and £25,000 for the disposition fund, showed a net profit of £68,000 less than for the previous year. The company purposes to reduce its dividend from 12 per cent to 10 per cent and to carry forward £60,000 as in 1912-13. The Siemens Elektrische Betriebe A.G., Berlin, one of the few German companies which have no interest in central stations in hostile territory, intends to distribute the same dividends as in the previous year, the net profits having been £20,000 more in 1913-14 than in 1912-13. The Siemens-Schuckertwerke reduced the dividend from 10 per cent to 7½ per cent, although the results for the year ended July 31, 1914, would have permitted the payment of the original amount, £125,000 having been allotted to the reserve fund. The Elektricitäts A.G. vorm. Schuckert & Company, Nuremberg, reduced dividends from 8 per cent to 6½ per cent and carried forward £66,000 as compared with £63,000 in the previous year, the net profits having decreased £60,000. The Elektricitäts A.G. vorm. H. Poge, Chemnitz, declared a dividend of 4 per cent in contrast with 7½ per cent of the last year, having placed £8,000 in reserve for war risk. The Elektrische Licht und Krafts Anlagen A.G., Berlin, reduced dividends from 7½ per cent to 5 per cent for the year ended Sept. 30, 1914, net profits having shrunk £44,000 in spite of an increase of £1000 in gross profits.

Manufacturing and Industrial

The Gould Storage Battery Company, 30 East Forty-second Street, New York, has opened an office in the Kerr Building, 100 Beaubien Street, Detroit, Mich.

The Kerr Turbine Company, Wellsville, N. Y., has appointed Mr. B. G. Fernald district manager of the New York office. The office is in Room 801, Singer Building.

Calendar with Map of War Area.—The Stuart-Howland Company, Boston, Mass., is sending out a calendar which shows a map of Central Europe with the fortified cities marked with red ink.

The Metalyte Company, New York, has appointed Mr. J. J. Steinharter, formerly in charge of the Winnipeg branch of the Laco-Phillips Company, second vice-president. Mr. Steinharter will look after the business of the company in Canada and in the northwestern section of the United States.

The Trumbull Electric Manufacturing Company, Plainville, Conn., has opened an office in San Francisco, Cal., the address being 595 Mission Street. Mr. W. P. Naser, for some years Western representative of the company, will be in charge of this office. It is the intention of the above company to have a large stock of its products in San Francisco.

Last Year a Good One for Small-Motor Manufacturer.—The Bell Electric Motor Company, Garwood, N. J., manufacturer of alternating-current motors, reports that its business for 1914 was about on a par with that for 1913 and was generally very good. The company is making single-phase machines up to 15 hp in rating and polyphase machines up to 40 hp.

Mr. E. W. Phillips, who formerly represented the Excello arc-lamp interests in this country, has been appointed to the detail and supply department staff of the Chicago office of the Westinghouse Electric & Manufacturing Company. Mr. Phillips will assist Mr. W. R. Pinckard, head of the department, who was recently elected president of the Chicago Electric Club.

Mr. George Kirchgasser has been appointed advertising manager of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., succeeding Mr. Charles L. Benjamin, who recently resigned to take up advertising work in Milwaukee. Mr. Kirchgasser has served as assistant advertising manager of the company for the last four years. Besides his advertising work, Mr. Kirchgasser has also contributed to the technical press a number of articles on wiring and other electrical subjects.

"Live-Wire" Club.—An organization composed of foremen and heads of various departments of the Burke Electric Company, Erie, Pa., and known as the Burke Electric Live Wire Club, recently held a meeting in the office of the company, and plans for wider social activity and more efficient co-operation among the employees of the various departments were discussed. This club has a membership of seventy-three. It holds an annual banquet during the winter months and also takes care of the shop picnic in the summer.

The Year 1914 a Big One in New York City for Electrical Instruments.—According to Mr. Stanley Brown, manager of the New York office of the Weston Electrical Instrument Company, Newark, N. J., the amount of business done by his office is only 2 per cent behind that of the best year the office has ever had and is 15 per cent better than that of the next best year. If it were not for the slackness in the building industry, Mr. Brown stated recently to a representative of the ELECTRICAL WORLD, the year would have been the best the company ever had in the New York territory.

Electric Washer Company Sustains Slight Loss by Fire.—Fire which broke out on the evening of Jan. 9 in a printing plant occupying a part of the same building with the factory of the Hurley Machine Company, 19 South Clinton Street, Chicago, destroyed about $15,000 worth of lumber and other raw materials belonging to the washing machine company. When interviewed by a representative of the ELECTRICAL WORLD, Mr. E. N. Hurley, president of the company, stated that the loss would in no way delay shipments and that the factory would be operating again under

normal conditions within two or three days. The material destroyed and damaged was fully covered by the insurance policies.

Import Duties on Automobiles and Accessories.—The Bureau of Foreign and Domestic Commerce of the United States Department of Commerce recently issued a report giving the rates of import duties on motor vehicles of all kinds and accessories in practically all foreign countries. The rates are given in both foreign quantities and weights and their American equivalents, inclusive of surtaxes and similar items which serve to increase the cost of importation. There is in addition a summary table in which the rates are arranged so as to facilitate comparison between various countries.

Insulated-Wire Business Slack.—According to an official of a prominent wire-manufacturing concern, the demand throughout the country for insulated wire at present is below normal. The number of employees in this company's plant has been reduced to about 35 per cent of what it usually is. The above official also declared to a representative of the ELECTRICAL WORLD that there are no prospects of immediate improvement. So far as foreign business is concerned, he stated, American manufacturers whose product conforms to Underwriters' regulations cannot compete successfully in foreign countries where requirements are different.

Recording-Instrument Business Outlook.—The last week of 1914 was a particularly good one for the Bristol Company, Waterbury, Conn. Considerable business has also been done since the first of the year, especially in New York and vicinity. Among recent orders received for the company's instrument have been several from worsted mills in New Jersey. The Bristol Company is benefiting by the war as European competition has been practically eliminated. This is especially the case in Australia and Africa, where there is quite a demand for Bristol instruments. In South America and the Philippine Islands the company is finding business slow.

Electric Gear-Shifting Device at Automobile Shows.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., exhibited at the recent New York automobile show an electric gear shift for gasoline automobiles. The operation of this device, which eliminates the hand shifting of gears, is controlled by push-buttons mounted in the center of the steering wheel. The Winton 1915 six-cylinder car is provided with one of these electric gear-shifting mechanisms. Single-button push-and-pull automobile lighting switches and radiator caps, switch sub-bases, fuse boxes and motor terminal blocks made of "Pyroplax" were also shown. A similar exhibit will be placed on display at the coming Chicago automobile show.

Orders for Lighting Standards.—The Ornamental Lighting Pole Company, 114 Liberty Street, New York, manufacturer of plain and ornamental cast-iron poles for street lighting, railways and transmission systems, has recently received the following orders: City of Easton, Pa., 117 single-lamp units for nitrogen-filled lamps; city of Pittsfield, Mass., fifty-five single-lamp units for luminous-arc lamps; city of Bridgeport, Conn., 111 single-lamp units for luminous-arc lamps; the Cortland (N. Y.) County Traction Company, fifty-two poles for street-railway service, twenty-seven of which are equipped with lamps. The company anticipates a prosperous year. Inquiries both from foreign countries and this country are being received. The company has been shipping some standards to South America, through New York commission merchants.

Garment Makers Using Sewing-Machine Motors.—The General Electric Company, Schenectady, N. Y., is noting a demand for its motors designed to operate electric sewing machines. In this class of service the tendency is toward group drive and direct connection to the machine. Although the above company's business in other types of small motors has fallen off, that in sewing-machine motors has more than held its own. The general improvement in the manufacturing facilities of garment makers and also to some extent the need for more equipment on account of large war orders are said to have created a demand for these machines. With direct connection and group drive the motor is usually placed under a table, out of the way, and the noise and tendency to raise dust are reduced to a minimum. Among other kinds of service for which the small motor is adapted, the General Electric Company is expecting a demand this spring for machines to operate ice-cream freezers. This business is seasonal and is most extensive in the early summer.

Lamp Manufacturers' Window Displays.—The Edison Lamp Works of the General Electric Company, Harrison, N. J., are preparing material for window displays for Lincoln's Birthday, St. Valentine's Day and Washington's Birthday which they will send to dealers. The Edison Lamp Works are endeavoring to encourage the all-night use of lamps in homes to prevent burglary. One of the decorative schemes for windows includes a colored poster representing an armed burglar and two cardboard houses, one of them illuminated and the other dark. The burglar is placed between the two houses and his attitude is one of hesitancy. On a large placard is printed, "If you were a burglar which house would you choose?" Other placards announce that "A dark house is a temptation to thieves to break in and steal" and "The best burglar insurance is an Edison 'Mazda' lamp burning all night." The Edison Lamp Works are devoting much thought and attention to co-operative publicity and are prepared to send to the dealers a variety of booklets, bulletins, price lists with imprints, post cards, electrotypes for newspaper advertisements, lantern slides, street-car cards, material for lectures, etc.

Large Field for Small Generating Plants.—Fairbanks, Morse & Company, Chicago, Ill., makers of gas-engine-driven generating sets for both direct-current and alternating-current service, are disposing of a number of outfits in the West for the operation of town-lighting systems and industrial plants. The apparatus is designed for parallel operation, so that the rating of a plant may be increased by adding one or more units. The small direct-current sets are used extensively on estates and farms and by the United States and Canadian governments for lighthouses, naval and military stations, etc. Fairbanks, Morse & Company are also making various types of small motors, designed chiefly for industrial plants and for operating irrigation pumps. On account of the wet season in the Western States last year, the business in equipment for irrigation purposes fell off considerably. Recently Fairbanks, Morse & Company have resorted to the use of ball bearings on their direct-current motors. These bearings have already been successfully employed on their alternating-current machines. Direct-current motors with ratings up to 15 hp are being equipped with ball bearings, and it is the intention of the concern to make use of them on the larger machines. Another new development by Fairbanks, Morse & Company is an alternating-current drum-type controller. The contacts of the controller and the transformer are immersed in oil.

Mr. Charles L. Benjamin has resigned as advertising manager of the Cutler-Hammer Manufacturing Company, Milwaukee, Wis., to join Klau-Van Pietersom-Dunlap, Inc., Milwaukee, an advertising organization in which he has acquired an interest. Although Mr. Benjamin is perhaps best known among advertising men as an authority on technical and trade-paper advertising, his career in the general field has been an interesting one. He was the first editor of *Printer's Ink* when that journal was started in 1888, and he later became general publicity manager for the Century Company, publishers of the *Century Magazine* and the Century Dictionary. In these connections Mr. Benjamin was associated with Messrs. George P. Rowell, Richard Watson Gilder, T. L. De Vinne and other famous figures of the publishing field. In 1898 he enlisted as a volunteer soldier, serving in the Porto Rican campaign. After the withdrawal of the United States troops from Cuba he was retained by the Cuban government to supervise the instruction of the native employees. Later he returned to New York and edited *The Suburbanite*, issued by the Central Railroad of New Jersey. This publication achieved remarkable results in encouraging the migration of city dwellers to suburban homes in New Jersey. For the last eight years Mr. Benjamin has been advertising manager for the Cutler-Hammer company. He is a past-president of the Milwaukee Advertisers' Club and has been in demand as a speaker at many conventions of advertising and business men.

New Incorporations

The New Holland Light & Power Company has been incorporated with a capital stock of $6,000 to construct and operate an electric-light plant. The incorporators are Henry Cooper, James Ryan and G. A. Trenkle.

The Lower Milford Township Electric Light & Power Company and the Lower Macungie Township Electric Light & Power Company have received charters to supply electricity for lamps, heaters and motors in the districts for which they are named. The incorporators are H. R. Fehr, Charles Wagner and A. H. S. Cantlin, respectively president, treasurer and general manager of the Lehigh Valley Light & Power Company, of Allentown.

New Industrial Companies

The Kanaky Electric & Manufacturing Company, of Los Angeles, Cal., has been incorporated with a capital stock of $25,000 by H. P. Kanaky, S. E. Goar and E. E. Hull.

The Hucks Auto Electric Company, of Los Angeles, Cal., has been incorporated with a capital stock of $10,000. The directors are C. W. Sahland, A. M. Sahland and H. S. Laughlin.

The Wyre Sales Company, of Lima, Ohio, has been incorporated by J. J. Wyre, D. R. Wyre, J. L. Cable, C. M. Cable and W. B. O'Conner. The company is capitalized at $5,000 and proposes to deal in electrical supplies.

The Champion Electric Manufacturing Company, of New York, N. Y., has been chartered with a capital stock of $50,000 by Frank and Salvatore Scognamillo and Muro Lamparelli, 2312 Hughes Avenue, New York, N. Y.

The Four-M Tractor Company, of Chicago, Ill., has been incorporated with a capital stock of $100,000 by George A. Chritton, Oscar W. Youngquist and Albert Pack. The company proposes to manufacture and deal in dynamos.

The Williamson-Johnston Company, of McKeesport, Pa., has been chartered for the purpose of manufacturing all kinds of electrical appliances. The incorporators are G. S. Williamson, A. T. Johnston and H. Marwitz, of McKeesport.

The Self-Raising Seat Appliance Company, of Newark, N. J., has been incorporated by S. M. Eisner, L. Lasser, of Newark, N. J., and O. W. Jackson, of Brooklyn, N. Y. The company is capitalized at $100,000 and proposes to manufacture mechanical and electrical tools, devices and appliances.

The Motor Ignition & Device Company, of Clarksburg, W. Va., has been organized by Ellis R. Diehm, Ernest Angell, C. C. Owens, W. L. Fleming and Harold T. Clark, all of Cleveland, Ohio. The company is capitalized at $400,000 and proposes to manufacture ignition systems for gasoline motors.

The Pavey Electric Company, of Dunbar, W. Va., has been incorporated with a capital stock of $100,000 for the purpose of manufacturing electrical machinery. Samuel Pavey, Frank Pavey, of Indianapolis, Ind.; W. T. Moore and Fred Paul Grosscup, of Dunbar, W. Va., are interested in the company.

The Electric Protection Company, of Columbia, S. C., has filed application for a charter with the Secretary of State. The capital stock is placed at $5,000 with privilege to increase it to $25,000. The incorporators are B. F. Taylor, Wilie Jones, Joseph Norwood, Ashley C. Tobias, Jr., and W. B. Stuart.

The National Lighting Products Company, of Pittsburgh, Pa., has recently filed application for a charter with the Secretary of State. The company proposes to manufacture and deal in electric-lighting fixtures and accessories. The incorporators are F. C. Murdock, George E. Lanz, Robert E. Gannon, Vincent E. Truxell and W. E. Walsh.

The Asbestos Wood Manufacturing Corporation, of Poughkeepsie, N. Y., has been incorporated with a capital stock of $250,000 for the purpose of manufacturing fireproof and weatherproof materials, insulating material, etc.; also to do a general contracting and engineering business. The incorporators are H. H. Vail, R. F. Butts and C. J. Connally, of Poughkeepsie.

Trade Publications

Soldering Tool Holder.—The Vulcan Electric Heating Company, Buffalo, N. Y., has recently issued a leaflet describing its soldering tool holder.

Small Battery-Charging Outfit.—A small automobile battery-charging set is described in a catalog recently issued by the Lincoln Electric Company, Cleveland, Ohio.

Binding Posts.—Circular No. 21 sent out by the States Company, 19 New Park Avenue, Hartford, Conn., describes and illustrates several types of binding posts.

Outdoor Lighting Fixtures.—The Metal Arts & Crafts Company, Chicago, Ill., has issued a folder which lists and illustrates a number of cast-metal outdoor lighting fixtures.

High-Frequency Generator.—Bulletin No. 8-C sent out by the Victor Electric Company, Jackson Boulevard and Robey Street, Chicago, Ill., describes a high-frequency generator.

Sockets for High-Efficiency Lamps.—Harvey Hubbell, Inc., Bridgeport, Conn., has issued Bulletin No. 15-3, which is descriptive of a large-sized socket for nitrogen-filled lamps.

Electric Cord Adjuster.—The "Gowan" automatic lamp-cord adjusting device is described and illustrated in a circular issued by S. G. Forst & Company, 116 Church Street, Toronto, Ont.

Storage Batteries.—The Kentucky Revivo Battery Company, Louisville, Ky., has published a booklet which contains a number of letters commending the "Revivo" battery for electric vehicles.

Electric Sign.—Harvey, Deschere & Company, 1501 Garden Street, Hoboken, N. J., have published Catalog No. 7, which contains information on electric signs illuminated by miniature lamps.

Centrifugal Pumps.—The De Laval Steam Turbine Company, Trenton, N. J., has issued a 298-page catalog with more than 300 illustrations describing a number of different kinds of centrifugal pumps.

Reading-Lamp Fixture.—A stand equipped with a rack over which may be placed a reading lamp is described in a folder published by the R. M. Millar Electric Works, 9 South Clinton Street, Chicago, Ill.

Lighting and Ignition Battery.—The Electric Storage Battery Company has issued a catalog, designated as Section LI, which contains information on its "type LX Exide" battery for lighting and ignition service.

Steel Base for Battery Bell.—The P.R. Manufacturing Company, 621 Bellevue Avenue, Detroit, Mich., is sending out a folder the subject of which is a pressed-steel base for its "Eclipse" battery-operated bell.

Floor Outlet Extension.—The Bryant Electric Company, Bridgeport, Conn., is sending out a folder which is descriptive of a water-tight floor box connected by means of rigid conduit to a disappearing door receptacle.

Soldering Paste.—The M. W. Dunton Company, 150 Niagara Street, Providence, R. I., has issued a folder entitled "Soldering Kinks," which enumerates some of the uses to which its soldering paste can be put.

Signal System Testing Volt-Ammeters.—Direct-current and alternating-current testing volt-ammeters for railway signal systems are described in Bulletin Sheet No. 86, issued by the Roller-Smith Company, 203 Broadway, New York.

Watt-Hour Meters.—Bulletin No. 40, issued by the Sangamo Electric Company, Springfield, Ill., is attractively illustrated and contains information on alternating-current watt-hour meters for single-phase and polyphase service.

Jobber's Yearbook.—The 1915 yearbook issued by the Western Electric Company, New York, contains 1216 pages and is profusely illustrated. Uniform list prices are given, to which uniform discounts can be applied. The catalog also contains information on numerous selling helps.

Lungmotors.—The Life Saving Devices Company, 1009 Times Building, New York, has issued a card, 9½ in. by 11 in., containing fac-similes of clippings from various newspapers relating to the work of the lungmotor in restoring many persons overcome by smoke in the recent New York subway accident. An illustration on the card shows a lungmotor giving air to an asphyxiated adult.

Construction News

New England

GREENVILLE, MAINE.—The Greenville Lt. & Pwr. Co. has applied to the Public Utilities Commission for permission to purchase the property, rights and franchises of the Sebec Pwr. Co., the Sangerville Improvement Co. and the Dover & Foxcroft Lt. & Ht. Co. Charles D. Shaw, of Greenville, is president of the Greenville company.

FITCHBURG, MASS.—The town officials and the Board of Trade are considering the installation of new nitrogen tungsten lamps on Monument Square and through the entire business section, provided the merchants will co-operate.

LUNENBURG, MASS.—Application has been made by the Municipal Light Board of Lunenburg to the town of Leominster for a franchise to erect a transmission line from Lunenburg into Leominster.

SALEM, MASS.—The Salem El. Ltg. Co. has closed a contract with the Naumkeag Cotton Mills Co. to supply electricity to operate the plant of the latter company. The electric company will build an addition to its plant to enable it to supply the additional service.

WEST BOYLSTON, MASS.—Within the next four months the town of West Boylston expects to erect 3 miles of transmission line and to purchase meters, transformers and lighting arresters in connection with the municipal electric-lighting system. Arthur I. Hunting is superintendent.

HOPE VALLEY, R. I.—The Westerly Lt. & Pwr. Co., of Westerly, is contemplating extending its transmission lines to Hope Valley in the near future.

BRIDGEPORT, CONN.—Bids will be received by the Board of Contract and Supply, Room 28, City Hall, Bridgeport, until Feb. 1 for the construction of almshouse building, including electrical work and mechanical equipment. Drawings and specifications may be obtained upon application to the Board of Contract and Supply upon deposit of $25, which will be refunded upon return of same within ten days.

TORRINGTON, CONN.—Extensions are being made to the power plant of the Torrington El. Lt. Co., including the installation of one 1250-kva Parsons Westinghouse turbine, with Edwards air pump, Wheeler condenser and two 250-hp Beach boilers. Contracts have been placed for all equipment.

WINSTED, CONN.—The Winsted Gas Co. is installing one Ludlow waterwheel governor, two Tirrill regulators and one 250-hp Bigelow boiler. All contracts for equipment have been awarded.

Middle Atlantic

BATH, N. Y.—Bids will be received by Joseph A. Goulden, president of board of trustees, New York State Soldiers and Sailors' Home, Bath, until Feb. 2 for alterations to electric plant. Drawings and specifications may be consulted at the New York State Soldiers and Sailors' Home, Bath; at the New York office of the Department of Architecture, 1224 Woolworth Building, New York; at the Department of Architecture, Capitol, Albany. Drawings and specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany, upon deposit of $10, which will be refunded upon return of same. Lewis F. Pilcher is state architect.

BINGHAMTON, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until Jan. 21, for construction, heating, plumbing and electric work for new building for chronic patients, and for new boiler stack, etc., at the Binghamton State Hospital, Binghamton. Drawings and specifications may be consulted at the Binghamton State Hospital, at the New York office of the Department of Architecture, Room 1224, Woolworth Building, and at the Department of Architecture, Capitol, Albany. Drawings and specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany, upon deposit of $10 for each division of the work, to be refunded upon return of same. Lewis F. Pilcher is state architect.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, until Jan. 25 for installing electric equipment in new Public School 95, corner of Van Sicklen Street and Neck Road, borough of Brooklyn. Blank forms, plans and specifications may be obtained or seen at the office of the superintendent and also at branch office, 131 Livingston Street, Brooklyn.

MINETTO, N. Y.—Several parcels of land have recently been transferred to the Columbia Mills Pwr. Co., which is buying up property in Minetto for a large power development here.

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner of water supply, gas and electricity, Room 2342, Municipal Building, New York, until Jan. 18 for furnishing and delivering incandescent electric lamps. Blank forms of bids, proposals and contract, including specifications, may be obtained at Room 2324, Municipal Building.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, corner of Park Avenue and Fifty-ninth Street, New York, until Jan. 18 for electric work for workshop in cellar in Public School 109, 219 East Ninety-ninth Street, borough of Manhattan. Blank forms, plans and specifications may be obtained or seen at the office of the superintendent, Hall of Board of Education, Park Avenue and Fifty-ninth Street, borough of Manhattan.

PORT CHESTER, N. Y.—The Board of Trustees, it is reported, has decided to establish an ornamental lighting district in North and South Main Streets. The plans provide for the installation of 67 standards carrying four lamps each.

POUGHKEEPSIE, N. Y.—Bids will be received by the State Capitol Commission, Capitol, Albany, until Jan. 21 for furnishing motor for laundry at the Hudson River State Hospital, Poughkeepsie. Drawings and specifications may be obtained at the Hudson River State Hospital, Poughkeepsie; at the New York office of the Department of Architecture, Room 1224, Woolworth Building, New York, and at the Department of Architecture, Capitol, Albany. Lewis F. Pilcher is state architect.

TROY, N. Y.—The extension of the ornamental lighting system on Third Street from Congress Street to Ferry Street is under consideration.

WALDEN, N. Y.—The Public Service Commission has granted the Wallkill Valley El. Lt. & Pwr. Co., of Walden, permission to issue $23,500 in bonds, of which the proceeds of $4,075 will be used for the erection of a transmission line between Pine Bush and Walden.

ALLENTOWN, PA.—The contract for the electrical installation (except fixtures) for the rear wing of the new Lehigh County court house has been awarded to the Commercial Construction Co., of New York, N. Y. The grand jury has recommended that the construction work for the entire building be started as soon as the portion now under way is completed. The entire building when completed will cost more than $1,000,000. R. S. Rathburn is supervising engineer.

BATH, PA.—Plans are being considered by the Council for the installation of a municipal electric-light system.

EASTON, PA.—The City Council has recently awarded the contract for the installation of the ornamental street-lighting system to the Macan Jr. Co., of Easton. The contract provides for 117 single lamp standards carrying 600-cp nitrogen tungsten lamps, maintained by underground wires. The cost of the work is placed at $15,000, of which $6,500 is for the standards complete and $8,500 for installation of system. A. T. Koehler, of Easton, consulting and electrical engineer, has charge of the work.

MEADVILLE, PA.—Plans are being considered by the County Commissioners for lighting the court house by electricity.

PHILADELPHIA, PA.—Bids will be received by George W. Norris, director Department of Wharves, Docks and Ferries, 555 Bourse Building, Philadelphia, Pa., until Feb. 15 for furnishing electric hoists at Southwark Piers in the Delaware River between Catherine and Christian Streets. For details see proposal columns.

QUAKERTOWN, PA.—The Borough Council is considering plans for the installation of a new fire-alarm system.

UNION DEPOSIT, PA.—The installation of an electric street-lighting system in the spring is under consideration.

NEWARK, N. J.—The Maas & Waldstein Co., it is reported, contemplates the construction of a new power plant at its factory, at Avenue R and Passaic River.

TRENTON, N. J.—Plans are being considered, it is reported, by the Trenton, Lakewood & Seacoast Ry. Co. for the erection of three power stations to supply energy to operate its railway, contract for which was recently awarded. The proposed railway will run from Trenton to Point Pleasant, via Lakewood.

WESTON, W. VA.,—The Weston El. Lt., Pwr. & Wtr. Co. has awarded a contract to the Triumph Ice Machine Co., of Cincinnati, for a 20-ton ice plant.

GRUNDY, VA.—The City Council is contemplating the installation of a municipal electric-light plant. It is also proposed to build an ice factory in connection with the electric plant.

WASHINGTON, D. C.—Plans and specifications for a central heating, lighting and power plant to be erected in the city of Washington, under the direction of the supervising architect's office, will be ready for delivery on or after Jan. 15. Bids may be submitted for the entire work or for any of the following sections: Power-plant building complete, with steel smoke-stacks; boilers; generating apparatus; pumping equipment; condensers; coal and ash handling apparatus; steam and water piping; switching gear; tunnels; substation apparatus, etc. The department will be able to allow only 15 days for preparation of estimates. For details see proposal columns. O. Wenderoth is supervising architect.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 2, for furnishing at the various navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 7803—4000 searchlight carbons, 100,000 ft. double conductor, 36,000 ft. telephone card, 5500 ft. twin conductor wire, 1300 ft. brass conduit; Schedule 7800—72,000 ft. lamp cord; Schedule 7813—miscellaneous steel boiler tubes, Norfolk, Va., Schedule 7816—miscellaneous induction motors. Newport, R. I., Schedule 7809—500 lb. sheet copper, 105,000 brass tubes, 2000 lb. brass tubing. East and West, Schedule 7798—miscellaneous positive and negative tandem plates. Boston, Mass., Schedule 7805—miscellaneous unions, Boston, Mass., and Brooklyn, N. Y. Schedule 7805—miscellaneous composition pipe fittings. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—Foreign trade opportunities are announced by the Bureau of Foreign and Domestic Commerce in the Commerce Reports as follows: No. 15,129—An American consular officer in the United Kingdom reports that a dealer in his district desires to be put into communication with manufacturers of copper, brass and phosphor-bronze wire, and any other product of the allied branch of electrical trade. No. 15,054—An American diplomatic officer in a foreign country reports that his cooperation has been solicited in an endeavor to secure shipments of copper from United States to two foreign governments. No. 15,058—The Bureau of Foreign and Domestic Commerce is in receipt of a communication from a business man in South America who desires to establish commercial relations with manufacturers of gasoline and electric motor cars for railroad service. He states that he now has an inquiry for two cars and trailers. No. 15,061—A firm of wholesale merchants and importers in Canada has informed an American consul that it desires to be put in touch with manufacturers and dealers in miniature auto and flashlight tungsten lamps. No. 15,076—An American consular officer in the East Indies reports that a gas company in a city in his district is in the market for yellow-flame carbons for magazine arc lamps, size 12 in. by 7 mm. The company desires to form commercial relations for future business. No. 15,082—An American consul in one of the British possessions reports the name and address of an electric-light company which will soon be in the market for carbons. No. 15,073—A business man in Southern Europe informs an American consular officer that he desires to import coal, typewriters, tool grinders, automobiles, lighting fixtures, vacuum cleaners, pianos and piano-players. He desires to consider agencies for other lines of American goods. Correspondence should be in Spanish if possible. The consular officer requests that his office be supplied with duplicate copies of the catalogs. No. 15,140—An American consular officer in one of the neutral European countries states that a firm in his district wishes to communicate with American manufacturers of wireless-telegraph apparatus which may be used in field service. Catalogs and prices should be sent at once. Correspondence may be in English. No. 15,141—A firm in France informs an American consular officer that it desires to secure names and addresses of American manufacturers of soft-steel wire in the following dimensions: 0.05906 in., 0.066929 in. and 0.070826 in. in diameter. Correspondence should be in French. Weights, sizes and measurements should be expressed in the metric system; prices quoted in francs and c. i. f. French port. No. 15,143—A merchant in Spain informs an American consul that he wishes to communicate with American manufacturers of

electrolytic copper wire. Catalogs, prices and samples should be sent immediately. Correspondence should be in Spanish. No. 15,144—An American consular officer in the East Indies reports that a navigation company in his district is desirous of being placed in communication with manufacturers in the United States of carbons for searchlamps. The firm, it is stated, can furnish satisfactory references. Correspondence may be in English. No. 15,164—A business man in New Zealand has informed an American consul that he is desirous of getting into communication with manufacturers and exporters of optical goods and electrical appliances for wireless telegraphy. It is explained that he is particularly anxious to do business with firms on the Pacific Coast. No. 15,165—An American consular officer in the Far East reports that a dealer in his district desires to receive price lists, etc., catalogs of sheet and galvanized iron, sheet iron for boilers, electric lamps, etc. Catalogs, etc., should be in Russian or German. The consul states that if catalogs in the English language are sent through the consulate he will assist in making translations for the prospective buyer. No. 15,173—An American consular officer in Europe reports that he is in receipt of a communication from a corporation in his district, which operates five electric power plants throughout the country, requesting to be put in communication with American manufacturers and dealers in copper cables, copper wire and drawn copper tubes. No. 15,182—An American consular officer reports that a royal decree has been published authorizing the purchase of four electrically operated cranes for use in the port of Valencia, Spain. Plans and specifications are on file in the office of the Secretaria de la Junta de Obras del Puerto de Valencia, Valencia, and in the office of the Ministerio de Fomento, Secion de Puetos, Madrid. A list of persons who are in a position to represent American firms may be obtained on application to the Bureau of Foreign and Domestic Commerce and its branches. No. 15,184—An electrical engineer of one of the leading cities in South America has requested an American consular officer to secure for him catalogs, etc., of electrical supplies, including wire, cable and conduit, etc. Prices should be f.o.b. New York or, preferably, c. i. f. destination. Catalogs in Portuguese are preferred. No. 15,198—A business firm in Italy reports to an American consul that it wishes to receive offers, accompanied by catalogs, etc., on movable and stationary vacuum cleaners, with a view of securing the exclusive agency for that country. Correspondence may be in English. No. 15,203—An agent in Europe informs an American consular officer that he desires to obtain offers accompanied by catalogs for refrigerating and ice-making machinery for large plants. He desires to secure an exclusive agency for that country. No. 15,220—An American consular officer in Canada reports that a firm in his district desires to be put in touch with American manufacturers of electric-lighting fixtures, with a view of representing them in that market on a commission basis. No. 15,231—An American consular officer in one of the neutral countries has transmitted a detailed report covering a number of opportunities for the sale in his district of metals and metal alloys, shovels, spades, jacks for automobile trucks, magnetos and spark plugs, leather for automobiles and boot and shoe making, and wheat. A copy of the report may be obtained upon application to the Bureau of Foreign and Domestic Commerce or its branches. No. 15,243—A firm in South America has informed an American consul that it desires to import electrical appliances in general, telephone and telegraph supplies, rubber goods for automobiles, pharmacies and industrial purposes. Correspondence should be in Spanish. No. 15,251—An American consul in South America reports the name and address of a firm which is negotiating with the government for the installation of a modern telephone system. One member of the firm, it is stated, is an American. No. 15,260—An American consular officer in Russia reports that a business man in his district desires to secure names and addresses of firms in the United States manufacturing or dealing in electric lamps, electric mountings, dynamos, coupling for engines, steam engines, tools of every description, hand and steam pumps, belting, etc. Correspondence may be in Russian, French or German. No. 15,265—An American consular officer in the Far East reports that a firm in his district desires catalogs, price lists and discounts on steam engines and boilers for electric power plants and electrical machinery (direct current). Correspondence may be in English. No. 15,270—An importing company in the United Kingdom advises an American consular officer that it wishes to purchase large quantities of porcelain electrical fittings. It is stated that this firm has formerly transacted extensive business with American exporters and manufacturers. No. 15,274—An American consular officer in the Far East has transmitted the name and address of a business man in his district who wishes to get into communication with American firms which export carborundum. He also wishes quotations on carborundum similar to each of the samples, which may be inspected at the Bureau of Foreign and Domestic Commerce or its branches. The commodity should be packed in boxes of 125 lb. net weight each. He desires to enter into a yearly contract for monthly shipments and would also like to receive counter samples. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or to its following branches: Room 409, United States Custom House, New York, N. Y.; 629 Federal Building, Chicago, Ill.; 1020 Hibernia Bank Building, New Orleans, La.; 310 United States Custom House, San Francisco, Cal.; 52 Post Office Building, Atlanta, Ga.; 922 Alaska Building, Seattle, Wash.; 752 Oliver Building, Boston, Mass., and 402 Third National Bank Building, St. Louis, Mo.

North Central

FREMONT, MICH.—At a special election held Jan. 4 the citizens voted in favor of granting the Grand Rapids-Muskegon Pwr. Co. of Grand Rapids a franchise to supply electricity in Fremont. The power company will take over the municipal electric-light plant at $13,000.

GLADSTONE, MICH.—Within the next 30 days the managers of the municipal electric-light plant expect to purchase an electric fire whistle, 10 closed-circuit single-stroke bells and one electro-mechanical bell for closed circuit. G. A. Fragoner is superintendent.

HILLSDALE, MICH.—The City Council has authorized the Board of Public Works to dismantle the old 80-hp boiler in the municipal electric-light plant and install a new 350-hp water-tube boiler with stoker and equipment. The cost is estimated at $7,500.

PORT AUSTIN, MICH.—The Village Council is considering the question of establishing a municipal electric-light plant in Port Austin.

SAGINAW, MICH.—A petition is being circulated by John C. Davies asking the City Council to call a special election on Feb. 23, 1915, to vote on a proposal to issue $750,000 in bonds to install a municipal electric-light plant and distributing system in Saginaw.

BUCYRUS, OHIO—Preparations are being made by the Bucyrus Lt. & Pwr. Co. for the installation of additional equipment in its plant, including turbo-generators, boilers, condensers, etc. Contracts for machinery have already been placed. A. G. Moser is superintendent.

CLEVELAND, OHIO.—The city of Cleveland will install 550 new ornamental street lamps. It is not yet decided when the work will be done.

CLEVELAND, OHIO.—Bids will be received by A. R. Callow, commissioner of purchases and supplies, 513 City Hall, Cleveland, until Jan. 22, for furnishing insulated lead-covered cable for the municipal electric-light department. Bids will also be received at the same time and place for electric meters for the municipal electric-light department. Specifications may be obtained at the office of the commissioner of the light and heat division, 1443 East Third Street, Cleveland.

ELYRIA, OHIO.—The construction of a joint municipal electric-lighting plant by the cities of Elyria and Lorain has been proposed by the Councilmen of both cities.

MARTINS FERRY, OHIO—Improvements are contemplated to the municipal electric-lighting plant, including the installation of new arc machines and engine.

TIFFIN, OHIO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 8, for construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Tiffin. Drawings and specifications may be obtained at the above office or from the custodian of site at Tiffin. O. Wenderoth is supervising architect.

TOLEDO, OHIO—Bids will be received by the Board of Commissioners of Lucas County, Court House, Toledo, until Jan. 29 for construction of power house and furnishing equipment for a new heating, lighting and power plant for the Lucas County Children's Home. E. Bayer, Nicholas Building, Toledo, is engineer.

BRADENBURG, KY.—W. D. Coleman, it is reported, has purchased the electric-light franchise and will install an electric-light plant in Bradenburg.

DANVILLE, KY.—The installation of an ornamental lighting system on Lexington Avenue is under consideration.

LOUISVILLE, KY.—The Louisville Bridge & Iron Co., it is reported, is contemplating changing all of its motors from direct to alternating current and will soon purchase new motors aggregating several hundred horse-power.

NEWPORT, KY.—Plans are being considered by the City Council for operating the municipal water-works pumping station by electricity. Estimates of cost of pumping the water by electricity are being prepared by the Union Lt., Ht. & Pwr. Co., of Cincinnati.

ROCKPORT, KY.—The Town Council, it is reported, has granted a franchise for the construction of an electric-light plant and water-works system in Rockport.

INDIANAPOLIS, IND.—The Indiana Public Service Commission has authorized the Merchants' Ht. & Lt. Co., of Indianapolis, to issue $281,232 in bonds and $75,206 in capital stock, the proceeds to be used to carry out its contract with the city for street-lighting, etc.

CARRIERS MILLS, ILL.—The State Public Utilities Commission has authorized the Carrier Mills Utilities Co. to issue $5,000 in capital stock.

CHICAGO, ILL.—Bids will be received by J. F. Neil, secretary of the South Park Commissioners, Fifty-seventh Street and Grove Avenue, Chicago, until Jan. 20, for one year's supply of incandescent lamps, beginning Feb. 1, 1915.

GALVA, ILL.—The Galva El. Lt. Co. has applied to the State Public Utilities Commission for a certificate of convenience and necessity to erect and maintain a transmission line from the village of Victoria to the junction with the existing line of the company for the purpose of supplying electricity in Victoria.

HOOPESTON, ILL.—Plans are being considered for the installation of a municipal electric-lighting plant in connection with the city water-works system.

MIDDLETOWN, ILL.—Plans are being considered for the installation of a municipal electric-light plant to furnish electricity for lighting the streets and for commercial purposes.

ROCHESTER, ILL.—Application has been made to the Village Board by the Haas El. Co., of Springfield, for a franchise to install and operate an electric-light plant for a period of 20 years.

STREATOR, ILL.—A committee has been appointed by the Commercial Club to make investigations relative to the installation of an ornamental lighting system in Streator.

WARREN, ILL.—The Warren Lt. & Pwr. Co. has applied to the State Public Utilities Commission for permission to erect a transmission line from Warren to Apple River and also to construct a general distributing system in Apple River.

GRANTSBURG, WIS.—A petition has been presented to the City Council to have a survey made to ascertain the feasibility of damming the Wood River in Grantsburg to obtain power to operate the municipal electric-light plant.

MANITOWOC, WIS.—All bids received for furnishing a 500-hp steam plant for the municipal water and lighting plant, it is reported, have been rejected by the City Council. New bids will not be called until a decision has been reached on the offer of the Busch-Sulzer Brothers-Diesel Engine Co., of St. Louis, Mo., to install an oil-engine-driven generating unit. Henry Stolze is Mayor.

OREGON, WIS.—The installation of a municipal electric-light plant in Oregon is reported to be under consideration.

ELMORE, MINN.—The installation of an electric-lighting system in Elmore is reported under consideration. H. Merrifield is said to be interested in the project.

HENNING, MINN.—The Village Board is reported to have granted a franchise to V. Herman, of St. Cloud, to install an electric-lighting system in Henning.

MILLVILLE, MINN.—The installation of an electric-lighting system in Millville is reported to be under consideration.

MINNEAPOLIS, MINN.—A detailed statement covering the public work to be recommended by the Minnesota State Board of Control to be done in the next two years has been completed by the board for presentation to the Legislature, which convenes this month. The specific electrical improvements, aside from the electrical work involved in other buildings under consideration, are as follows: To be completed in 1915 and 1916—School for the Blind, Red Wing; rewiring main building, superintend-

ent's residence, hospital and barn, $2,000; power plant at School for Feeble-minded, Fairbault, $30,000; State Public School, Owatonna, heating and power plant, $100,000, underground electric feeder system, $5,000; Home School for Girls, Sauk Center, wiring hospital attic, $350; State Reformatory, St. Cloud, underground feeders and ground lighting system, $4,000; State Sanitarium, Walker Roentgen-ray installation, $5,000, ground lighting, telephone system and electric service extension, $6,500; Hospital for Inebriates, Willmar, power-plant improvements, $1,000. To be completed 1916-1917, School for Deaf, Faribault, rewiring laundry and hospital, $2,000; School for Feeble-minded, Faribault, rewiring laundry and hospital, ground lighting system, $2,000; State Training School, Red Wing, ground lighting system and underground feeders, $10,000.

RUSHMORE, MINN.—An electric-lighting system is being installed in Rushmore. Electricity to operate the system will be obtained from the municipal electric plant at Worthington, 10 miles distant. A 6600-volt transmission line is now being erected to supply the service.

WINDOM, MINN.—At an election held recently the proposal to issue $25,000 bonds for improvements to the municipal electric-lighting system was carried.

CEDAR FALLS, IA.—Plans are being considered by the Union Milling Co., of Cedar Falls and Waterloo, for developing the water-power of Cedar River to supply electricity to operate its mills and also for other industries.

DES MOINES, IA.—The Continental Gas & El. Corpn., of Cleveland, it is reported, will soon apply to the City Council for a franchise to construct and operate a central heating plant and an electric-lighting system in Des Moines. W. H. Abbott, Cuyahoga Building, Cleveland, is president of the company.

PRAIRIE HOME, MO.—The Town Board, it is reported, has granted Kelly Simmons a franchise to construct and operate an electric-light plant in Prairie Home for a period of 20 years.

ST. LOUIS, MO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 30, for new plumbing, new conduit and wiring system and interior lighting fixtures for the United States custom house at St. Louis, Mo. Drawings and specifications may be obtained from the above office or from the custodian of site at St. Louis. O. Wenderoth is supervising architect.

GRANO, N. D.—Steps have been taken by the local business men to install an electric-lighting plant in Grano.

TRENT, S. D.—Application has been made to the Town Board by the Flandreau Lt. & Pwr. Co., of Flandreau, for a franchise to supply electricity in Trent. The franchise will be submitted to the voters.

VERMILION, S. D.—The City Commissioners are considering the proposal to purchase the electric plant owned by the Vermilion Milling & El. Co., to be owned and operated by the municipality.

LINCOLN, NEB.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 18 for interior lighting fixtures for the United States post office and court house at Lincoln. Drawings and specifications may be obtained from the above office or from the custodian of site at Lincoln. O. Wenderoth is supervising architect.

GREAT BEND, KAN.—Plans are being considered by the merchants of Great Bend for the installation of an ornamental lighting system in the business district.

Southern States

GREENSBORO, N. C.—The Revolution Cotton Mills, which is enlarging its plant at a cost of $1,250,000, to be completed in May, it is reported, expects later to install an electric power plant. At first energy will be secured from the transmission lines of the Southern Pwr. Co., of Charlotte, N. C.

CHARLESTON, S. C.—Preparations are being made by the Charleston Consol. Ry. & Ltg. Co. for extending its car line from the navy yard to North Charleston, a distance of about 2 miles.

TOCCOA, GA.—The installation of a municipal electric-lighting plant in Toccoa is under consideration.

FELLSMERE, FLA.—Plans are being considered, it is reported, by Robert Kaun for the installation of an isolated electric-light plant, to be operated by power from artesian well.

DYERSBURG, TENN.—The city of Dyersburg is considering the purchase of one 1,000,000-gal., two-stage centrifugal pump, directly connected to a 2300-volt, three-phase motor, one 40-gal.-per-minute vertical centrifugal pump, directly connected to a 20-volt, three-phase motor, and also one carload of poles. S. R. Blakeman is superintendent of water and light plant.

EMBREEVILLE, TENN.—The erection of a transmission line from Jonesboro to Embreeville (a distance of 8 miles), it is reported, is under consideration by the Tennessee Eastern El. Co., of Johnson City. The company proposes to furnish energy to operate the zinc mines in Embreeville.

SHELBYVILLE, TENN.—The Jacobs Auto Co., of Shelbyville, it is reported, is contemplating the purchase of a generator set for recharging storage battery.

BLYTHEVILLE, ARK.—The power house of the local electric-light plant and ice factory, it is reported, is being remodeled and the capacity of both plants doubled. W. W. Hollipeter is manager.

AMITE, LA.—Improvements are contemplated by the Central Lt. & Pwr. Co., of Amite, it is reported, including the installation of two oil engines in its power house and the erection of arc lamps on the principal streets.

NEW ORLEANS, LA.—The New Orleans Ry. & Lt. Co., it is reported, is preparing plans for building about 11 miles of new track in New Orleans. M. S. Sloan is general manager.

LAWTON, OKLA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until March 6 for construction complete, including mechanical equipment (except elevator and approaches), of the United States post office and court house at Lawton, Okla. Drawings and specifications may be obtained after Jan. 23 from the custodian of site at Lawton, or from the above office. O. Wenderoth is supervising architect.

GAINESVILLE, TEX.—The City Council has appointed a committee to secure estimates of the cost of installing an electric-lighting plant in connection with the water-works system.

TEMPLE, TEX.—The installation of a new fire-alarm system in Temple is under consideration by the City Council.

WOLFE CITY, TEX.—The Wolfe City Lt. Co., recently organized, with a capital stock of $6,000, is contemplating the construction of an electric-light and power plant. M. Tasker is reported interested.

Pacific States

ENUMCLAW, WASH.—An option on the local electric-light plant has been secured by the Puget Sound Trac., Lt. & Pwr. Co., of Seattle. The plant, it is understood, will be remodeled and new machinery installed. When improvements are completed the service will be extended to Wilkeson, Carbonado, Burnett and other points in this section.

SEATTLE, WASH.—The Puget Sound Trac., Lt. & Pwr. Co., a subsidiary of the Stone & Webster Management Association, of Boston, Mass., has recently purchased about 3000 acres in Skagit County, together with water rights on Baker River, with a view of developing the water-power.

SEATTLE, WASH.—A preliminary permit has been granted, it is stated, to the city of Seattle for the development of water-power on the Sauk and Suiattle Rivers in Skagit County. The city engineering department has reported favorably on the feasibility of developing the project.

TACOMA, WASH.—Bids will be received by James C. Drake, commissioner of light and water, until Jan. 20, for furnishing material for local improvement district No. 5501, according to plans and specifications on file in the office of the commissioner of light and water as follows: For 27,000 ft. No. 10 lead-covered, galvanized, armored parking cable; eight 3-kw, 60-cycle transformers to operate on 2300-volt multiple circuit, delivering 6.6 amp to series circuit, and 126 lamp standards.

DALLAS, ORE.—The City Council is negotiating with the Oregon Pwr. Co. for lighting the business section with 100-cp incandescent lamps.

AUBURN, CAL.—Preliminary arrangements have been made by Lawrence Gardelia, of Oroville, who is building a gold dredger at Gold Hill, for the erection of a 10,000-volt transmission line from Ophir to the dredge. The proposed line will be from 3 to 4 miles long and will tap the main high-tension lines from Drumm to Ophir. About 600 hp will be required to operate the dredge.

GREENVILLE, CAL.—The Plumas Lt. & Pwr. Co. has applied to the State Railroad Commission for authority to issue $100,000 in bonds and to sell $52,000 of them at not less than 80, the proceeds to be used to construct an electric plant to supply electrical service in Greenville, Crescent Mills, Taylorsville and the surrounding territory. The company is already furnishing electricity for lamps in this district. By a lease with the Round Valley Wtr. Co. the Plumas company has secured control of about 1000 hp of potential electrical energy and proposes to develop same.

WILLIAMS, CAL.—Plans are being considered for lighting the streets of the town with electricity. The Northern California Power Co., of San Francisco, has offered to supply the service.

HOLBROOK, ARIZ. (not a post office).—Louis S. Frith, of Gallup, is contemplating the installation of an electric-lighting plant and ice factory in Holbrook. The present plans provide for the installation of one 75-hp to 100-hp boiler, one 75-hp engine, one 50-kw, three-phase, 60-cycle generator, switchboard and about 10 transformers from 1 kw to 5 kw; about two miles of wire for distributing system will be required and from 75 to 100 meters.

PHOENIX, ARIZ.—The Falls Pwr. & El. Co., a co-operative company composed of farmers residing northeast of Phoenix, has obtained a franchise to erect a transmission line from the Arizona Falls power plant to supply energy to a number of irrigation pumping plants and for other industrial purposes.

MILES CITY, MONT.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 27 for construction complete, including mechanical equipment, lighting fixtures and approaches, of the United States post office at Miles City, Mont. Drawings and specifications may be obtained at the above office or from the custodian of site at Miles City, Mont. O. Wenderoth is supervising architect.

PUEBLO, COL.—An ordinance is being prepared by the Council to submit an $80,000 bond issue to the taxpayers at the election next spring for the purpose of establishing a municipal electric-light plant in Pueblo.

Canada

BROCKVILLE, ONT.—Plans are being considered by the Hydro-Electric Power Commission of Ontario for furnishing the rural district west of Brockville with electrical energy from the local plant. It is proposed to include the area of several summer resorts along the river for a distance of 7 miles. The transmission line will be erected by the commission. Electricity will also be supplied to many of the large farmers along the line.

ILDERTON, ONT.—The by-law authorizing debentures for the installation of hydroelectric power will be submitted to the ratepayers on Jan. 25.

MERRICKVILLE, ONT.—The dam, now being constructed at Merrickville, by the Dominion government to maintain navigation is nearly completed. The Rideau Pwr. Co., of Merrickville, has been permitted to install twin pipes 8 ft. in diameter through the dam for the purpose of developing power to generate electricity. The minimum quantity to be developed is 1600 hp. The power plant will be equipped with a generating capacity of about 2000 hp. The cost of the power house is estimated at about $40,000. Contracts have been placed for turbines and electrical apparatus.

MIMICO, ONT.—The by-law providing for an issue of $3,000 in debentures for extensions to the hydroelectric system of the village was passed by the ratepayers.

SANDWICH, ONT.—At an election held recently the by-law providing for the installation of hydroelectric power was carried.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JAN. 5, 1915.

As noted in our Current News Section, the number of United States patents dated Jan. 5, 1915, was the largest ever issued in one week. On account of the delay in printing these patents, copies were received from Washington too late to be abstracted for use in this issue of the ELECTRICAL WORLD. Abstracts will appear in our next issue.